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ART. XXVI.—*On the Origination and Distribution of Vegetable Species:—Introductory Essay to the Flora of Tasmania;* by Dr. JOSEPH D. HOOKER.

(Continued from p. 25.)

§ 4. *On the General Phenomena of the Distribution of Plants in Time.*

A THIRD class of facts relates to the antiquity of vegetable forms and types on the globe, as evidenced by fossil plants. The chief facts relating to these are the following:—

31. The earliest Flora of which we know much scientifically, is that of the Carboniferous formation. We have indeed plants that belonged to an earlier vegetation, but they do not differ in any important respects from those of the carboniferous formation.

Now the ascertained features of the coal vegetation may be summed up very briefly. There existed at that time,—

Filices, in the main entirely resembling their modern representatives, and some of which may even be generically, though not specifically, identical with them.

Lycopodiaceæ; the same in the main characters as those now existing, and, though of higher specialization of stem, of greater stature, of different species, and perhaps also genera, from modern *Lycopodiaceæ*, yet identical with these in the structure of their reproductive organs and their contents, and in the minute anatomy of their tissues.

Coniferæ. The evidence of this order is derived chiefly from the anatomical characters of the Dicotyledonous wood so abundantly found in the coal, and which seems to be identical in all important respects with the wood of modern genera of that order, to which must be added the probability of *Trigonocarpon* and *Nœggerathia* being Gymnospermous, and allied to *Salisburia*.* On the other hand, it must not be overlooked that no Coniferous strobili have been hitherto detected in the Carboniferous formation.

Cycadeæ. Some fragments of wood, presenting a striking similarity in anatomical characters to that of *Cycadeæ*, have been found in the carboniferous series.

In the absence of the fructification of *Calamites*, *Calamodendron*, *Halonia*, *Anabathra*, etc., there are no materials for any safe conclusions as to their immediate affinities, beyond that they all seem to be allied to Ferns or *Lycopodiaceæ*. But the same can hardly be said of the affinities of *Volkmannia*,† *Antholites*, and others, which have been referred, with more or less probability, to Angiospermous Dicotyledons.

The Permian Flora is for the most part specifically distinct from the Carboniferous, but many of its genera are the same. The prevalent types are Gymnospermous Dicotyledons, especially *Cycadeæ*, and a great abundance of Tree-ferns.

The New Red Sandstone, or Trias group, presents plants more analogous to those of the Oolite than to those of the Carboniferous epoch, but they have also much in common with the latter. *Voltzia*, a remarkable genus of Conifers, appears to be peculiar to this period.

In the Lias numerous species of *Cycadeæ* have been found, with various Conifers and many Ferns. No other Dicotyledonous or any Monocotyledonous plants have as yet been discovered, but it is difficult to believe that none such should have existed at a period when wood-boring and herb-devouring insects, belonging to modern genera, were extremely abundant, as has been proved by the researches of Mr. Brodie and Mr. Westwood.‡

The Oolite contains numerous *Cycadeæ*, *Coniferæ*, and Ferns, and more herbivorous genera of insects; and here Monocotyledonous vegetables are recognizable in *Podocarya* and other Pandaneous plants. A cone of *Pinus* has been discovered in the Purbeck, and one of *Araucaria* in the inferior Oolite of Somersetshire.

* Phil. Trans., 1855, p. 149.

† See Quarterly Journal of the Geological Society, May, 1854.

‡ These insects include species of the existing common European genera, *Elater*, *Gryllus*, *Hemerobius*, *Ephemera*, *Libellula*, *Panorpa*, and *Carabus*. Of all conspicuous tribes of plants the *Cycadeæ*, *Filices*, *Coniferæ*, and *Lycopodiaceæ* perhaps support the fewest insects, and the association of the above-named insects with a vegetation consisting solely or mainly of plants of these orders is quite inconceivable.

In the Cretaceous group, Dicotyledons of a very high type appear. A good many species are enumerated* by Dr. Debey, of Aix-la-Chapelle, including a species of *Juglans*, a genus belonging to an order of highly-developed floral structure and complex affinities.†

Characeæ appear for the first time at this epoch, and are apparently wholly similar in structure to those of the present day.

The Tertiary strata present large assemblages of plants of so many existing genera and orders, that it can hardly be doubted but that even the earliest Flora of that period was almost as complex and varied as that of our own. In the lowest Eocene beds are found *Anonaceæ*, *Nipa*, *Acacia*, and *Cucurbitaceæ*.‡ In the Bagshot sands some silicified wood has been found, which may confidently be referred to *Banksia*, and which is, in fact, scarcely distinguishable from recent and fossil Australian Banksia wood.§

In the brown coal of the Eocene and Miocene periods, Fan-palms, Conifers, and various existing genera of *Myriceæ*, *Laurineæ*, and *Plataneæ* are believed to have been identified. Wesel and Weber describe from the brown coal of the Rhine a rich and varied Flora, representing numerous families never now seen associated, and including some of the peculiar and characteristic genera of the Australian, South African, American, Indian, and European floras.‖

* Quart. Journ. Geol. Soc., vii, pt. 1, misc., p. 110.

† Professor Oswald Heer, of Zurich, in an interesting little paper (Quelques Mots sur les Noyers), in Bibl. Univ. Genev., Sep. 1858, argues from the fact of the early appearance of *Juglans* in the geological series, that this genus must be a low type of the Dicotyledonous class to which it belongs. The position of *Juglans* is unsettled in the present state of our classification of Dicotyledonous orders, as it has equal claims to be ranked with *Terebinthaceæ*, which are very high in the series, and with *Cupuliferæ*, which are placed very low; and were the grounds for our thus ranking these orders based on characters of ascertained relative value, such an argument might be admissible; but the system which sunders these orders is a purely artificial one, and *Juglans* with its allies would prove it so, if other proofs were wanting; for it absolutely combines *Terebinthaceæ* and *Cupuliferæ* into one natural group, in which (as in so many others) there is a gradual passage from great complexity of floral organs to great simplicity.

‡ I am far from considering the identification of these and the other genera which I have enumerated in various strata as satisfactory, but I conclude that they may be taken as evidence of as highly developed and varied plants having then existed as are now represented by these genera.

§ I am indebted to the late Robert Brown for this fact, and for the means of comparing the specimens, which are beautifully opalized. I ascertained that he was satisfied with the evidence of this wood having really been dug up near Staines, though it is so perfectly similar in every respect to the opalized Banksia-wood of Tasmania as to suggest to his mind and my own the most serious doubts as to its English origin.

‖ See Quart. Journ. Geol. Soc., xv, misc. 3, where an abstract is given, with some excellent cautions, by C. J. F. Bunbury, Esq. The Australian genera include *Eucalyptus*, *Casuarina*, *Leptomeria*, *Templetonia*, *Banksia*, *Dryandra*, and *Hakea*. I am not prepared to assert that these identifications, or the Australian ones of the Mollasse, are all so unsatisfactory that the evidence of Australian types in the brown coal and Mollasse should be altogether set aside; but I do consider that not one of the above-named genera is identified at all satisfactorily, and that many of them are not even problematically decided.

In the Mollasse and certain Miocene formations at Œningen and elsewhere in Germany, Switzerland, and Tuscany,* 900 species of Dicotyledons† have been observed, all apparently different from existing ones. They have been referred, with more or less probability, to Fan-palms, Poplars (three species), evergreen *Laurineæ*, *Ceratonia*, *Acacia*, *Tamarindus*, *Banksia*, *Embothrium*, *Grevillea*, *Cupressus*, several species of *Juglans* (one near the North American *J. acuminata*, another near the common walnut of Europe and Asia, *J. regia*, and a third near the North American *J. cinerea*); also a Hickory, near the *Carya alba* (a genus now wholly American), and a *Pterocarya* closely allied to *P. Caucasica*.

The rise of the Alps was subsequent to this period; and in the European deposits immediately succeeding that event, in Switzerland (at Durnten and Utznach) are found evidences of the following existing species,—Spruce, Larch, Scotch Fir, Birch, a Hazel (different from that now existing), *Scirpus lacustris*, *Phragmites communis*, and *Menyanthes trifoliata*.

The glacial epoch followed, during and since which there has probably been little generic change in the vegetation of the globe.

32. So much for the main facts hitherto regarded as established in Vegetable Palæontology. They are of little value as compared with those afforded by the Animal Kingdom, even granting that they are all well made out, which is by no means the case. In applying them theoretically to the solution of the question of creation and distribution, the first point which strikes us is the impossibility of establishing a parallel between the successive appearances of vegetable forms in time, and their complexity of structure or specialization of organs, as represented by the successively higher groups in the natural method of classification. Secondly, that the earliest recognizable Cryptogams

* During the printing of this sheet I have received from my friend M. DeCandolle a very interesting memoir on the tertiary fossil plants of Tuscany, by M. C. Gaudin and the Marquis C. Strozzi, in which some of the genera here alluded to are described. The age of these Tuscan beds is referred by Prof. O. Heer to a period intermediate between those of Utznach and Œningen. The most important plants described are, Coniferæ 6 sp., Salix 2, Liquidambar 1, Alnus 1, Carpinus 1, Populus 2, Fagus 1, Quercus 5, Ulmus 2, Planera 1, Ficus 1, Platanus 1, Oreodaphne 1, Laurus 2, Persea 1, Acer 2, Vitis 1, Juglans 4, Carya 1, Pterocarya 1. There are 49 extinct species in all, of which 46 are referred, without even a mark of doubt or caution, to existing genera, and this in almost all cases from imperfect leaves alone! Without questioning the good faith or ability of the authors of this really valuable and interesting memoir, I cannot withhold my protest against this practice of making what are at best little better than surmises, appear under the guise of scientifically established identifications. What confidence can be placed in the positive reference of supposed fossil Fungi to *Sphæria*, or of pinnated leaves to *Sapindus*, and other fragments of foliage to existing genera of *Laurineæ*, *Ficus*, and *Vitis*!

† O. Heer, Sur les Charbons feuilletés de Durnten et Utznach, in Mem. Soc. Helvet. Sc. Nat. 1857; Bibl. Univers. Genev., August, 1858.

should not only be the highest now existing, but have more highly differentiated vegetative organs than any subsequently appearing; and that the dicotyledonous embryo and perfect exogenous wood with the highest specialized tissue known (the coniferous, with glandular tissue*), should have preceded the monocotyledonous embryo and endogenous wood in date of appearance on the globe, are facts wholly opposed to the doctrine of progression, and they can only be set aside on the supposition that they are fragmentary evidence of a time further removed from that of the origin of vegetation than from the present day; to which must be added the supposition that types of *Lycopodiaceæ*, and a number of other orders and genera, as low as those now living, existed at that time also.

33. Another point is the evidence,† said to be established, of genera now respectively considered peculiar to the five continents having existed cotemporaneously at a comparatively recent geological epoch in Europe, and the very close affinity, if not identity, of some of these with existing species. The changes in the level and contour of the different parts of the earth's surface which have occurred since the period of the chalk, or even since that preceding the rise of the Alps, imply a very great amount of difference between the past and present relations of sea and land and climate; and it is no doubt owing to these changes that the *Araucariæ*, which once inhabited England, are no longer found in the northern hemisphere, and that the Australian genera which inhabited Europe at a period preceding the rise of the Alps have since been expelled.

34. Such facts, standing at the threshold of our knowledge of vegetable palæontology, should lead us to expect that the problem of distribution is an infinitely complicated one, and suggest the idea that the mutations of the surface of our planet, which replace continents by oceans, and plains by mountains, may be insignificant measures of time when compared with the duration of some existing genera and perhaps species of plants, for some of these appear to have outlived the slow submersion of continents.

* The vexed question of the true position of Gymnospermous plants in the Natural System assumes a somewhat different aspect under the view of species being created by progressive evolution. In the haste to press the recent important discoveries in vegetable impregnation and embryogeny into the service of classification, the long-established facts regarding the development of the stem, flower, and reproductive organs themselves of Gymnospermous plants have been relatively underrated or wholly lost sight of; and if an examination of the doctrines of progression and variation lead to a better general estimation of the comparative value of the characters presented by these organs, the acceptance or rejection of the doctrines themselves is, in the present state of science, a matter of secondary importance.

† See fifth foot-note of p. 307 (‖): what I have there said of the supposed identifications of the Australian genera applies to many of those of the other enumerated quarters of the globe.

35. From the sum then of our theories, as arranged in accordance with ascertained facts, we may make the following assumptions:—That the principal recognized families of plants which inhabited the globe at and since the Palæozoic period still exist, and therefore have as families survived all intervening geological changes. That of these types some have been transferred, or have migrated, from one hemisphere to another. That it is not unreasonable to suppose that further evidence may be forthcoming which will show that all existing species may have descended genealogically from fewer pre-existing ones; that we owe their different forms to the variation of individuals, and the power of limiting them into genera and species to the destruction of some of these varieties, etc., and the increase of individuals of others. Lastly, that the fact of species being with so much uniformity the ultimate and most definable group (the leaves as it were of the family tree), may possibly be owing to the tendency to vary being checked, partly by the ample opportunities each brood of a variety possesses of being fertilized by the pollen of its nearest counterpart, partly by the temporary stability of its surrounding physical conditions, and partly by the superabundance of seeds shed by each individual, those only vegetating which are well suited to existing conditions. An appearance of stability is also, in the case of many perennials, due to the fact that the individuals normally attain a great age,* and thus survive many generations of other species, of which generations some present characters foreign to their parents.

36. In the above line of argument I have not alluded to the question of the origin of those families of plants which appear in the earliest geological formations, nor to that of vegetable life in the abstract, conceiving these to be subjects upon which, in the present state of science, botany throws no light whatever. Regarded from the classificatory point of view, the geological history of plants is not altogether favorable to the theory of progressive development, both because the earliest ascertained types are of such high and complex organization,† and because there are no known fossil plants which we can certainly assume to be-

* In considering the relative amount and rate at which different plants vary, it should be remembered that we habitually estimate them not only loosely but falsely. We assume annuals to be more variable than perennials, but we probably greatly overrate the amount to which they really are so, because a brief personal experience enables us to study many generations of an annual under many combinations of physical conditions; whereas the same experience embraces but a fractional period of the duration of (comparatively) very few perennials. It has also been well shown by Bentham (in his paper on the British Flora, read [1858] before the Linnæan Society) that an appearance of stability is given to many varieties of perennials, through their habitual increase by buds, offsets, etc., which propagate the individual; and in the case of *Rubi*, which comparatively seldom propagate by seed, a large tract of ground may be peopled by parts of a single individual.

† I have elsewhere stated that I consider the evidence of *Algæ* having existed at a period preceding vascular Cryptogams to be of very little value. (Lond. Journ. Bot., viii, p. 254.)

long to a non-existing class or even family, or that are ascertained to be intermediate in affinity between recent classes or families.*

The progress of investigation may ultimately reveal the true history of the unrecognized vegetable remains with which our collections abound, and may discover to us amongst them new and unexpected organisms, suggesting or proving a progressive development; but in the meantime the fact remains that the prominent phenomena of vegetable palæontology do not advance us one step towards a satisfactory conception of the first origin of existing natural orders of plants.

Taking the Conifers for an example, whatever rank is given to them by the systematist, that they should have preceded Monocotyledons and many Dicotyledons in date of appearance on the globe, is a fact quite incompatible with progressive development in the scientific acceptation of the term, whilst to argue from their apparently early appearance that they are low in a classificatory system is begging the question.

Another fact to be borne in mind is, that we have no accurate idea of what systematic progression is in botany. We know little of high and low in the Vegetable Kingdom further than is expressed by the sequence of the three classes, Dicotyledons, Monocotyledons, and Acotyledons; and amongst Acotyledons, of Thallogens being lower than Acrogens, and of these that the Mosses, etc., are lower than Filices and their allies. It is true that we technically consider multiplication and complexity of floral whorls in phænogamic plants as indications of superior organization; but very many of the genera and orders most deficient in these respects are so manifestly reduced members of others, which are indisputably the most complex in organization in the whole Vegetable Kingdom, that no good classification even has been founded on these considerations alone.†

* It must not be supposed that in saying this I am even expressing a doubt as to there having been plants intermediate in affinity between exi-ting orders and classes. Analogy with the animal kingdom suggests that some at any rate of the plants of the coal epoch do hold such a relationship; but should they not do so, I consider this fact to be of little value in the present inquiry, for I incline to believe that the ascertained geological history of plants embraces a mere fraction of their whole history.

† The subject of the retrogression of types has never yet been investigated in botany, nor its importance estimated in inquiries of this nature. To whatever order we may grant the dignity of great superiority or complexity, we find that order containing groups of species of very simple organization; these are moreover often of great size and importance, and of wide geographical distribution. Such groups, if regarded *per se*, appear to be far lower in organization than other groups which are many degrees below them in the classified series; and our only clue to their real position is their evident affinity with their complex co-ordinates;—destroy the latter by a geological or other event, and all clue to the real position of the former may be lost. Are such groups of simply-constructed species created by retrogressive variation of the higher, or did the higher proceed from them by progressive variation? If the latter, did the simpler forms precede in origin the highest forms of all other groups which rank below them in the classified series?

37. Again, it is argued by both Mr. Darwin and Mr. Wallace that the general effects of variation by selection must be to establish a general progressive development of the whole animal kingdom. But here again in botany we are checked by the question, What is the standard of progression? Is it physiological or morphological? Is it evidenced by the power of overcoming physical obstacles to dispersion or propagation, or by a nice adaptation of structure or constitution to very restricted or complex conditions? Are cosmopolites to be regarded as superior to plants of restricted range, hermaphrodite plants to unisexual, parasites to self-sustainers, albuminous-seeded to exalbuminous, gymnosperms to angiosperms, water plants to land, trees to herbs, perennials to annuals, insular plants to continental? and, in fine, what is the significance of the multitudinous differences in point of structure and complexity, and powers of endurance, presented by the members of the Vegetable Kingdom, and which have no recognized physiological end and interpretation, nor importance in a classificatory point of view? It is extremely easy to answer any of these questions, and to support the opinion by a host of arguments, morphological, physiological, and teleological; but any one gifted with a quick perception of relations, and whose mind is stored with a sufficiency of facts, will turn every argument to equal advantage for both sides of the question.

To my mind, however, the doctrine of progression, if considered in connection with the hypothesis of the origin of species being by variation, is by far the most profound of all that have ever agitated the schools of Natural History, and I do not think that it has yet been treated in the unprejudiced spirit it demands. The elements for its study are the vastest and most complicated which the naturalist can contemplate, and reside in the comprehension of the reciprocal action of the so-called inorganic on the organic world. Granting that multiplication and specialization of organs is the evidence and measure of progression, that variation explains the *rationale* of the operation which results in this progression, the question arises, What are the limits to the combinations of physical causes which determine this progression, and how can the specializing power of Nature stop short of causing every race or variety ultimately to represent a species? While the psychological philosophers persuade us that we see the tendency to specialize pervading every attribute of organic life, mental and physical; and the physicists teach that there are limits to the amount and duration of heat, light, and every other manifestation of physical force which our senses present or our intellects perceive, and which are all in process of consumption; the reflecting botanist, knowing that his ultimate results must accord with these facts, is perplexed at feeling

that he has failed to establish on independent evidence the doctrines of variation and progressive specialization, or to co-ordinate his attempts to do so with the successive discoveries in physical science.

38. Before dismissing this subject, I may revert once more to the opposite doctrine, which regards species as immutable creations, and this principally to observe that the arguments in its favor have neither gained nor lost by increased facilities for investigation, or by additional means for observation. The facts are unassailable that we have no direct knowledge of the origin of any wild species; that many are separated by numerous structural peculiarities from all other plants; that some of them invariably propagate their like; and that a few have retained their characters unchanged under very different conditions and through geological epochs. Recent discoveries have not weakened the force of these facts, nor have successive thinkers derived new arguments from them; and if we hence conclude from them that species are really independent creations and immutable, though so often illimitable, then is all further inquiry a waste of time, and the question of their origin; and that of their classification in Genera and orders, can, in the present state of science, never be answered; and the only known avenues to all means of investigation must be considered as closed till the origin of life itself is brought to light.

39. Of these facts the most important, and indeed the only one that affords a tangible argument, is that of genetic resemblance. To the tyro in Natural History all similar plants may have had one parent, but all dissimilar plants must have had dissimilar parents. Daily experience demonstrates the first position, but it takes years of observation to prove that the second is not always true. There are, further, certain circumstances connected with the pursuit of the sciences of observation which tend to narrow the observer's views of the attributes of species; he begins by examining a few individuals of many extremely different kinds or species, which are to him fixed ideas, and the relationships of which he only discovers by patient investigation; he then distributes them into genera, orders, and classes, the process usually being that of reducing a great number of dissimilar ideas under a few successively higher general conceptions; whilst with the history of the ideas themselves, that is, of species, he seldom concerns himself. In a study so vast as botany, it takes a long time for a naturalist to arrive at an accurate knowledge of the relations of genera and orders if he aim at being a good systematist, or to acquire an intimate knowledge of species if he aim at a proficiency in local floras, and in both these pursuits the abstract consideration of the species itself is generally lost sight of; the systematist seldom returns to it, and

the local botanist, who finds the minutest differences to be hereditary in a limited area, applies the argument derived from genetic resemblance to every hereditarily distinct form.

40. It has been urged against the theory that existing species have arisen through the variation of pre-existing ones and the destruction of intermediate varieties, that it is a hasty inference from a few facts in the life of a few variable plants, and is therefore unworthy of confidence, if not of consideration; but it appears to me that the opposite theory, which demands an independent creative act for each species, is an equally hasty inference from a few negative facts in the life of certain species,* of which some generations have proved invariable within our extremely limited experience. These theories must not, however, be judged of solely by the force of the very few absolute facts on which they are based. There are other considerations to be taken into account, and especially the conclusions to which they lead, and their bearing upon collateral biological phenomena, under which points of view the theory of independent creations appears to me to be greatly at a disadvantage. For according to it every fact and every phenomenon regarding the origin and continuance of species, but that of their occasional variation, and their extinction by natural causes, and regarding the *rationale* of classification, is swallowed up in the gigantic conception of a power intermittently exercised in the development, out of inorganic elements, of organisms the most bulky and complex as well as the most minute and simple; and the consanguinity of each new being to its pre-existent nearest ally, is a barren fact, of no scientific significance or further importance to the naturalist than that it enables him to classify. The realization of this conception is of course impossible; the boldest speculator cannot realize the idea of a highly organized plant or animal starting into life within an area that has been the field of his own exact observation† and research; whilst the more cautious advocate hesitates about admitting the origin of the simplest organism under such circumstances, because it compels his subscribing to the doctrine of the "spontaneous generation" of living beings of every degree of complexity in structure and refinement of organization.

* See paragraph 4, where I have stated that the grand total of unstable species probably exceeds that of the stable.

† It is a curious fact (illustrative of a well-known tendency of the mind), that the few writers who have in imagination endeavored to push the doctrine of special creations to a logical issue, either place the scene of the creative effort in some unknown, distant, or isolated corner of the globe, removed far beyond the ken of scientific observation, or suppose it to have been enacted at a period when the physical conditions of the globe differed both in degree and kind from what now obtain: thus in both cases arguing *ad ignotum ab ignoto*.

On the other hand, the advocate of creation by variation may have to stretch his imagination to account for such gaps in a homogeneous system as will resolve its members into genera, classes, and orders; but in doing so he is only expanding the principle which both theorists allow to have operated in the resolution of some groups of individuals into varieties. And if, as I have endeavored to show, all those attributes of organic life which are involved in the study of classification, representation, and distribution, and which are barren facts under the theory of special creations, may receive a rational explanation under another theory, it is to this latter that the naturalist should look for the means of penetrating the mystery which envelops the history of species,—holding himself ready to lay it down when it shall prove as useless for the further advance of science, as the long serviceable theory of special creations, founded on genetic resemblance, now appears to be.

The arguments deduced from genetic resemblance being (in the present state of science), as far as I can discover, exhausted, I have felt it my duty to re-examine the phenomena of variation in reference to the origin of existing species. These phenomena I have long studied independently of this question; and when treating either of whole floras or of species, I have made it my constant aim to demonstrate how much more important and prevalent this element of variability is than is usually admitted, as also how deep it lies beneath the foundations of all our facts and reasonings concerning classification and distribution. I have hitherto endeavored to keep my ideas upon variation in subjection to the hypothesis of species being immutable; both because a due regard to that theory checks any tendency to careless observation of minute facts, and because the opposite one is apt to lead to a precipitate conclusion that slight differences have no significance; whereas, though not of specific importance, they may be of high structural and physiological value, and hence reveal affinities that might otherwise escape us. I have already stated how greatly I am indebted to Mr. Darwin's* *rationale* of the phenomena of variation and natural selection in the production of species; and though it does not positively establish the doctrine of creation by variation, I expect that every additional fact and observation relating to species will gain great additional value from being viewed in reference to it, and that it will materially assist in developing the principles of classification and distribution.

* In this Essay I refer to the brief abstract only (Linn. Journ.) of my friend's views, not to his work now in the press, a deliberate study of which may modify my opinion on some points whereon we differ. Matured conclusions on these subjects are very slowly developed.

[This extensive Essay proceeds to consider the Flora of Australia under § 1. General Remarks. 2. Estimate of the numbers, distribution, and affinity of the Classes, Orders, &c. 3. The Australian distribution of Natural Orders. 4. The Genera of the Australian Flora. 5. The Tropical Australian Flora. 6. The Flora of Extra-tropical Australia. 7. The Flora of Countries around Spencer's Gulf. 8. The Tasmanian Flora, an analysis of its elements and the geographical distribution of the species and their allies. 9. The New Zealand and Polynesian features of the Australian vegetation. 10. The Antarctic plants of Australia. 11. The South African features of Australian vegetation. 12. The European features of the Australian Flora. 13. On the Fossil Flora of Australia and its Geology in relation to the existing Flora. 14. On some of the naturalized Plants of Australia. 15. A List of some of the Esculent Plants of Australia. 16. Outlines of the progress of Botanical Discovery in Australia, etc.—From the large amount of matter suitable to our pages, we have space for only two of the shorter of the sections.]

General Remarks on the Flora of Australia.

The Flora of Australia has been justly regarded as the most remarkable that is known, owing to the number of peculiar forms of vegetation which that continent presents. So numerous indeed are the peculiarities of this Flora, that it has been considered as differing fundamentally, or in almost all its attributes, from those of other lands; and speculations have been entertained that its origin is either referable to another period of the world's history from that in which the existing plants of other continents have been produced, or to a separate creative effort from that which contemporaneously peopled the rest of the globe with its existing vegetation; whilst others again have supposed that the climate or some other attribute of Australia has exerted an influence on its vegetation, differing both in kind and degree from that of other climates. One of my objects in undertaking a general survey of the Australian Flora, has been to test the value of the facts which have given rise to these speculations, and to determine the extent and comparative value of a different and larger class of facts which are opposed to them, and which might also give some clue to the origin of the flora, and thus account for its peculiarities. This I pursued under the impression that it is the same with the study of whole floras as of single species or their organs, viz., that it is much easier to see peculiarities than to appreciate resemblances; and that important general characters which pervade all the members of a family or flora, are too often overlooked or undervalued, when associated with more conspicuous differences which enable us to dismember them. The result has proved, as I anticipated, that, the great difficulty being surmounted of collecting all the materials and so classifying them as to allow of their being generalized upon, the peculiarities of the flora, great

though they be, are found to be more apparent than real, and to be due to a multitude of specialities affecting the species, and to a certain extent the genera, but not extending to the more important characteristics of the vegetation, which is not fundamentally different from that of other parts of the globe.

Before proceeding to the discussion of the elements of the Australian Flora, I shall shortly describe its general character, viewed in the double light of a peculiar vegetation and as a part of the existing flora of the globe. Its chief peculiarities are:—

That it contains more genera and species peculiar to its own area, and fewer plants belonging to other parts of the world, than any other country of equal extent. About two-fifths of its genera, and upwards of seven-eighths of its species are entirely confined to Australia.

Many of the plants have a very peculiar habit or physiognomy, giving in some cases a character to the forest scenery (as *Eucalypti*, *Acaciæ*, *Proteaceæ*, *Casuarinæ*, *Coniferæ*), or are themselves of anomalous or grotesque appearance (as *Xanthorrhœa*, *Kingia*, *Delabechea*, *Casuarina*, *Banksia*, *Dryandra*, etc.).

A great many of the species have anomalous organs, as the pitchers of *Cephalotus*, the deciduous bark and remarkable vertical leaves of the *Eucalypti*, the phyllodia of *Acacia*, the fleshy peduncle of *Exocarpus*, the inflorescence and ragged foliage of many *Proteaceæ*.

Many genera and species display singular structural peculiarities, as the ovules of *Banksia*, calyptra of *Eucalyptus*, stigma of *Goodeniaceæ*, staminal column of *Stylidium*, irritable labellum of various *Orchideæ*, flowers sunk in the wood of some *Leptospermeæ*, pericarp of *Casuarina*, receptacle and inner staminodia of *Eupomatia*, stomata of *Proteaceæ*.

On the other hand, if, disregarding the peculiarities of the flora, I compare its elements with those of the floras of similarly situated large areas of land, or with that of the whole globe, I find that there is so great an agreement between these, that it is impossible to regard Australian vegetation in any other light than as forming a peculiar, but not an aberrant or anomalous, botanical province of the existing Vegetable Kingdom. I find:—

That the relative proportions of the great classes of Monocotyledons to Dicotyledons, of genera to orders, and of species to genera, are the same as those which prevail in other floras of equal extent.

That the subclasses distinguished by a greater or less complexity of the floral envelops, or their absence, as *Thalamifloræ*, *Calyciflorœ*, *Corolliflorœ*, etc., are also in the same relative proportions as prevail in other floras.

That the proportion of Gymnospermous plants to other Dicotyledons is not increased.

That all the Australian natural orders, with only two small exceptions, are also found in other countries; that most of those most widely diffused in Australia are such as are also the most widely distributed over the globe; and that Australia wants no known order of general distribution.

That the only two absolutely peculiar natural orders contain together only three genera, and very few species; they are, further comparatively local in Australia, and are rather aberrant forms of existing natural families than well-marked isolated groups: *Brunoniaceæ* being intermediate between *Goodeniaceæ* and *Compositæ*, and *Tremandreæ* between *Polygaleæ* and *Buettneriaceæ*.

That the large natural orders and genera, which, though not absolutely restricted to Australia, are there very abundant in species and rare elsewhere, and for which I shall hence adopt the term Australian, stand in very close relationship to groups of plants which are widely spread over the globe (as *Epacrideæ* to *Ericeæ*, *Goodeniaceæ* to *Campanulaceæ*, *Stylideæ* to *Lobeliaceæ*, *Casuarineæ* to *Myriceæ*).

That these Australian orders are exceedingly unequally distributed in Australia; that there is a greater specific difference between two quarters of Australia (southeastern and southwestern) than between Australia and the rest of the globe; and that the most marked characteristics of the flora are concentrated at that point which is geographically most remote from any other region of the globe.

That most of those Australian orders and genera which are found in other countries around Australia, have their maximum development in Australia at points approximating in geographical position towards those neighboring countries. Thus the peculiarly Indian features of the flora are most developed in northwestern Australia, the Polynesian and Malayan in northeastern, the New Zealand and South American in southeastern, and the South African in southwestern Australia.

That of the nine largest natural orders, which together include a moiety of the Australian species of flowering plants, no fewer than six belong to the nine largest natural orders of the whole world, and five belong to the largest in India also.

That in Australia itself, in advancing from the tropics to the coldest latitudes, or from the driest to the most humid districts, or from the interior to the seashore, or in ascending the mountains, the changes in vegetation are in every aspect analogous to what occur in other parts of the globe.

That the relations between the epochs of the flowering and the fruiting of plants, and the seasons of the year, are the same

in Australia as elsewhere, and most remarkably so; the *Orchidæ* being spring flowers, the *Leguminosæ* summer, the *Compositæ* autumn, and the *Cryptogamia* winter.

That the peculiarities of the Australian flora in no way disturb the principles of natural arrangement derived from the study of the flora of the globe apart from that of Australia. For, after having attempted to consider the Australian vegetation in a classificatory point of view, shutting out of my view, as far as I could, that of other countries, I have been led to the conclusion that the authors of the Natural System—Ray, Linnæus,* and the Jussieus—might have developed the same Natural System had they worked upon Australian plants instead of upon European.

I find further, that the classes, orders, genera, and species, may be about as well (or as ill) fixed or limited by a study of their Australian members as by those of any other country similarly circumstanced; and that there is the same vagueness as to the exact limits of natural groups, a similar inequality amongst them in numerical value and botanical characters, and an analogous difficulty in forming subclasses intermediate between classes and orders, as other floras present. The Australian flora, in short, neither breaks down nor improves the Natural System of plants as a whole, though it throws great light on its parts; the Australian genera fall into their places in that system well enough, though that system was developped before Australia was known botanically, and was chiefly founded upon a study of the vegetation of its antipodes.

Thus, whether the Australian flora is viewed under the aspect of its morphology and structure, as exhibited by its natural classification, or its numerical proportions or geographical distribution, it presents essentially the same primary features as do those of the other great continents: and it hence appears to me rash to assume that its origin belongs to another epoch of the earth's

* The real merits of Linnæus as a founder of the Natural System have never been appreciated. In the well deserved admiration of the genius and labors of the Jussieus, it is forgotten that the powers displayed by Linnæus in constructing the Genera Plantarum was not less (perhaps greater) than that exercised in grouping these into those genera of a higher value, which are now called Jussieuan Orders. The history of our Natural System presents but four salient points:—I. Ray's division of all plants into Phænogams and Cryptogams, and of the former into Monocotyledons and Dicotyledons. II. Linnæus's forming natural groups called genera, and rendering a knowledge of them acccessible to scientific minds by means of a binomial nomenclature and a mixed natural and artificial system of classes and orders. III. The Jussieus' combining most of the genera of Linnæus into truly natural orders, under Ray's classes, which classes they divided into subclasses as artificial as many of Linnæus's classes were. IV. The separation of Gymnosperms, by Brown, which is the first step towards a natural classification of the Jussieuan orders of Dicotyledons. (See Lond. Journ. of Bot. and Kew Gard. Misc., ix, 314, *note*.)

history than that of other floras, when the proportions of its classes, etc., are identically the same with these; or that it should be attributed to a distinct creative effort, if this is manifested only in effecting morphological differences requisite to constitute species and genera in our classification, without disturbing the proportions of these; or that the local influence of the Australian climate should be essentially different from that of other countries, and yet effect no physiological change in the periods of flowering and fruiting, or produce any other functional disturbances of the vegetable organisms, or affect the agency of humidity, temperature, soil, and elevation, on plants.

On the Fossil Flora of Australia, and its Geology in relation to the Existing Flora.

The fossiliferous rocks of Australia do not throw much light upon the antiquity of its existing flora, because of the hiatus which geologists seem to consider exists between the palæozoic and tertiary strata of that country. Mr. Jukes* has called attention to the curious fact that this deficient series in Australia is largely developed in Europe, and there presents such Australian forms of life as marsupiate quadrupeds, *Trigonia* and other fossil shells, together with Cycadeous plants. To the latter no importance can be attached, as this order is far more characteristic of tropical America, of India, and even of southeast Africa, than of Australia; but on the other hand the *Araucaria* of the English oolite, and other fossils alluded to at p. 308, would seem to tend to confirm Mr. Jukes's observation.

The so-called Palæozoic rocks of Australia contain fossil plants of which so little, botanically, is known, that it would be rash to speculate on their affinities, even if we knew the age of the beds they are found in, as compared with the European, which we do not. Their fossils comprise ferns of several genera, including the genus *Glossopteris*, which is found in the oolite beds of England, and in India;† *Phyllotheca*, a plant somewhat similar to *Casuarina*, but of extremely doubtful affinity; *Vertebraria*, also an Indian fossil, as to the affinities of which no plausible guess has been made; *Sphenopteris* and *Zygophyllites*, of which little more can be said. To these the Rev. W. B. Clarke‡ adds the following well-known British coal fossils,—*Lepidodendron*, *Halonia*, *Sigillaria*, *Ulodendron*, *Calamites*, and *Stigmaria*.

Many of the tertiary fossil plants of Australia would seem to be very closely allied to existing ones; these include the *Casuarina* cones of Flinders Island, the *Banksia* and *Araucaria* wood

* J. B. Jukes, 'Physical Structure of Australia,' p. 89, etc.
† M'Coy in Ann. Nat. Hist., vol. xx, p. 152.
‡ Journ. Geolog. Soc. Lond., vol. iv, p. 60.

of Tasmania, the *Banksia* cones of Victoria (which seem identical with those of *B. ericifolia*, though buried under many feet of trap). The leaves of the calcareous tuffs on the banks of the Derwent,* etc., appear however to belong to a different and warmer period.

From the above it would appear that the extinct flora of Australia was not entirely different from that now existing, and, following Mr. Jukes's line of argument, that Australia continued as dry land during the European Oolitic and Cretaceous periods. At this epoch Mr. Jukes assumes that the peculiar flora of Australia was introduced, and that the continent was again submerged during the Tertiary epoch, when it presented the appearance of two long islands, or chains of islands, one, the larger, representing the elevated land of eastern Australia and Tasmania, the other that of southeastern Australia, together with subsidiary groups in the western and northern parts of the continent.

These are the speculations of an able geologist and voyager, which I introduce without comment, and chiefly to observe that such a partition of the continent may be supposed to be favorable to the multiplication of forms of vegetable life out of fewer pre-existing ones, by the segregation of varieties. These groups of islands would present a precise analogy with the Galapagos and Sandwich groups, where we have the small islands of one Archipelago peopled by different species, and even genera. The subsequent elevation of these islets, and consequent union of them into larger ones, would further, according to Darwin's hypothesis (of the struggle of very different kinds of species and families for occupation of the soil resulting in a further separation of varieties into species), tend to enlarge the genera numerically within comparatively small geographical limits, and thus effect such a geographical distribution of plants as Australia now presents.

In our complete ignorance as to the condition of all the continents during the Palæozoic epoch, it is impossible to speculate on the earlier condition of the Australian flora. That previous to some Tertiary submersion of a great part of the continent, it was not altogether specifically different from what it now is, would appear from a fact insisted on by Mr. Jukes, that it was during such a submersion that those volcanos were active, the lavas of which now cover large tracts of southern Australia, and which we know to have buried a plant apparently identical with *Banksia ericifolia*, which is still one of the commonest trees in that part of the country: but the question of where the *Banksias* and their allies were created, and, if in other lands than

* Darwin's Journal, p. 535, and Volcanic Islands, p. 140; Strzelecki, p. 254; Milligan in Tasman. Journ., i, 131.

Australia, how they migrated thither, we have no means of answering. If the identifications of *Banksia* and other Proteaceous leaves in the Cretaceous and Miocene formations of Europe are worthy of confidence, it is possible that the Australian types may have migrated from the northern to the southern hemisphere, as, according to Darwin's speculations, the existing European plants in Australia have.

Some arguments in favor of the antiquity of the Australian flora as compared with the European may be derived from a consideration of its generic and ordinal peculiarities. If, as I have expressed it, a genus or order is rendered peculiar, that is, unlike its allies, by the extinction of the intermediate species, it follows that the greater the peculiarity the greater the number of lapsed forms. Applying this argument to the Australian flora, we must assume an extraordinary destruction of species that once linked it with the general flora of the globe, to account for its many peculiar genera, and these being represented by so many species. But as this destruction of species is primarily due to geological causes that influence climates, and so directly and indirectly lead to the extinction of species, and as geological events are of slow progress, it follows that we must regard the Australian flora as a very ancient one. Again, Darwin argues that a rich flora or fauna, marked by a preponderance of highly developed types, must have required a large area for its development: this is because, according to his view, the principle of natural selection favors the high forms, and is unfavorable to the low. Now it could easily be shown that the Australian flora is of as high a type as any in the globe, but under existing conditions has a very small area for its development, and presents fewer representatives of other floras to contend with than most; and we must hence, under these hypotheses, assume not only the antiquity of the flora, but that it was developed in a much larger area than it now occupies.

The only other geological speculation, founded upon anything like plausible grounds, that bears upon the origin of any of the plants now inhabiting Australia, is that of Mr. Darwin in reference to the European species, to which I have alluded at p. 23. It implies of course that the existing European types were introduced into the continent long subsequently to the peculiar Australian, and are plants of a later creation. I have already pointed out the difficulties attending its adoption, the chief of which is the admission of such a cold climate in the intertropical latitudes as that not merely a temperate, but a decidedly northern flora should have migrated across them; and that this migration, if conceded, must have been extensive and have introduced very many genera and species into the tropics appears likely, when we consider the fragmentary character of the assem-

blage of northern forms still left in Australia; for even when reduced to its most typical examples, it consists of nearly as many natural orders as species. The little colony of south Australian genera found under the equator, on Kini Balou, in Borneo, presents another difficulty, except indeed it be regarded as evidence of that previous southern migration of Australian forms from Europe to Australia, which I have just mentioned as conceivable.

There are then the Antarctic types to account for; were they of more recent introduction than the European or Australian? Darwin has alluded to the possibility of these having been transported by icebergs from higher southern latitudes, during a period of greater cold than now obtains in the southern hemisphere (as the Scandinavian and Arctic plants are supposed by Forbes to have been transported to Britain, etc., during the glacial period), and, with the north European plants already in Australia, to have ascended the mountains during the subsequent rise of temperature. This would imply that Australia was, during a cold Tertiary period, simultaneously peopled by all those Antarctic, European, and Australian types which now inhabit it, but that the latter flora was much less developed in number of species and genera than now; for I cannot but regard the Antarctic flora in the same light as the European, and as a mere fragment of a much more extensive one, whose other members perished in the battle for place waged with the European and Australian during those changes of climate and level that succeeded their first introduction. The ultimate numerical ascendancy of the Australian botanical element may have been gained during the subsequent partition of the continent into archipelagos of islands, which became so many colonies of Australian types of vegetation, prepared on the final rise of the land to descend and occupy the intermediate ground. The paucity of alpine plants of Australian genera is a fact which lends itself well to this idea; it implies that, during either the rise of land or increase of temperature, the tendency of the species of Australian type was to seek warmer regions, and that the boreal and antarctic types being better suited to a colder climate prevented to a great extent the establishment of such varieties of Australian type as might otherwise have been adapted to inhabit the same climate as themselves.

When I take a comprehensive view of the vegetation of the Old World, I am struck with the appearance it presents of there being a continuous current of vegetation (if I may so fancifully express myself) from Scandinavia to Tasmania; along, in short, the whole extent of that arc of the terrestrial sphere which presents the greatest continuity of land. In the first place, Scandinavian genera, and even species, reappear everywhere from Lap-

land and Iceland to the tops of the Tasmanian alps, in rapidly diminishing numbers it is true, but in vigorous development throughout. They abound on the Alps and Pyrenees, pass on to the Caucasus and Himalaya, thence they extend along the Khasia mountains, and those of the peninulas of India to those of Ceylon and the Malayan archipelago (Java and Borneo), and after a hiatus of 30°, they appear on the alps of New South Wales, Victoria and Tasmania, and beyond these again on those of New Zealand and the Antarctic Islands, many of the species remaining unchanged throughout! It matters not what the vegetation of the bases and flanks of these mountains may be; the northern species may be associated with alpine forms of Germanic, Siberian, Oriental, Chinese, American, Malayan, and finally Australian and Antarctic types; but whereas these are all, more or less, local assemblages, the Scandinavian asserts his prerogative of ubiquity from Britain to beyond its antipodes.

Next in importance and appearance along the arc indicated is that flora which may be called Himalayan,* and which consists of the endemic plants of that range, with a mixture of Siberian, Caucasian, and Chinese genera; this, gathering strength in its progress southeastward along the ranges of northern and eastern India, occupies the flanks of all the mountain-chains I have enumerated between the Caucasus and Malay Islands; but there the Himalayan flora disappears, and does not reappear in Australia or New Zealand, and scarcely a trace of it is found in Polynesia.

The Malayan flora† is in many respects closely allied to the Himalayan, but is wholly tropical in character. This also very gradually appears in the valleys of the western and central Himalaya, and multiplying in genera and species in the eastern Himalaya and Khasia ranges, it sweeps down the Malayan peninsula, occupies all the Malayan Islands, and then it too stops short without entering Australia, being, however, continued eastward in tropical Polynesia..

Lastly, there is the flora of the plains and lower hills of India,‡ which is of a drier character than the Malayan, and is equally characteristic of Africa. This commences gradually in northwest India, or even in eastern Persia, and occupies all central India, the Gangetic plain, the whole of the Madras peninsula, except the western coast and mountains, the valley of the Irrawaddi, and the lower flat districts of the Malay Islands, whence it is continued in great force over the whole of tropical Australia.

* Characterized by *Cupuliferæ, Magnoliaceæ, Ternstræmiaceæ, Laurineæ, Balsamineæ, Ericeæ, Fumariaceæ*, etc.

† *Vaccineæ, Rhododendron, Begoniaceæ, Quercus:* and equally typified by *Cyrtandraceæ, Dipterocarpeæ, Myristiceæ, Anonaceæ, Menispermeæ.*

‡ It consists of *Acanthaceæ, Sterculiaceæ*, and other orders, enumerated at p. xliii, *et seq.* [in the original Essay].

Reversing the position, and beginning at the southern extreme of this arc of vegetation, there is first the Antarctic flora (the complement of the Scandinavian), with its decided Australian representatives in *Centrolepideæ* and *Stylidieæ*, commencing in Fuegia, the Falklands, and Lord Auckland's and Campbell's group, reappearing in the alps of New Zealand, Tasmania, and Australia, and disappearing under the equator, on the alps of Borneo, being thus strictly confined to the southern hemisphere. Next there is the Australian flora proper, a large and highly developed one, diminishing rapidly after crossing the southern tropic, and as it advances towards the northwestern shore of the continent, reappearing in very small numbers in the Malay Islands, and terminated by a *Casuarina* on the east coast of the Bay of Bengal, and a *Stylidium* on the west. Not one representative of this vegetation advances further northwest.

Analogous appearances are presented by Africa and America. In Africa Indian forms prevail throughout the tropics, and, passing southwards, occupy the northern boundary of the south temperate zone; but there a very copious and widely different vegetation succeeds, of which but few representatives advance north to the tropic, and none to India, but with which are mingled Scandinavian genera and even species. In the New World, Arctic, Scandinavian, and North American genera and species are continuously extended from the north to the south temperate and even Antarctic zones; but scarcely one Antarctic species, or even* genus (*Forstera*, *Calceolaria*, *Colobanthus*, *Gunnera*, etc. etc.) advances north beyond the Gulf of Mexico.

These considerations quite preclude my entertaining the idea that the southern and northern floras have had common origin within comparatively modern geological epochs. On the contrary, the European and Australian floras seem to me to be essentially distinct, and not united by those in intervening countries, though fragments of the former are associated with the latter in the southern hemisphere. For instance, I regard the Indian plants in Australia to be as foreign to it, botanically, as the Scandinavian, and more so than the Antarctic; and that to whatever lengths the theory of variation may be carried, we cannot by it speculate on the southern flora being directly a derivative one from the existing northern. On the contrary, the many bonds of affinity between the three southern floras, the Antarctic, Australian, and South African, indicate that these may all have been members of one great vegetation, which may once have covered as large a southern area as the European now does a northern. It is true that at some anterior time these two

* *Acæna* is a remarkable exception.

floras may have had a common origin, but the period of their divergence antedates the creation of the principal existing generic forms of each. To what portion of the globe the maximum development of this southern flora is to be assigned, it is vain at present to speculate; but the geographical changes that have resulted in its dismemberment into isolated groups scattered over the Southern Ocean, must have been great indeed. Circumscribed as these floras are, and encroached upon everywhere by northern forms, their ultimate destiny must depend on that power of appropriation in the strife for place which we see in the force with which an intrusive foreign weed establishes itself in our already fully peopled fields and meadows, and of the real nature of which power no conception has been formed by naturalists, and which has not even a name in the language of biology. Everywhere, however, we see the more widely distributed, and therefore least peculiar forms of plants, spreading, and the most peculiar dying out in small areas, and the progress of civilization has introduced in man a new enemy to the scarce old forms, and a strong ally of those already common. Nor can it be doubted but that many of the small local genera of Australia, New Zealand, and South Africa, will ultimately disappear, owing to the usurping tendencies of the emigrant plants of the northern hemisphere, energetically supported as they are by the artificial aids that the northern races of man afford them.

ART. XXVII.—*On the Coloring Matter of the Privet and its application in the Analysis of Potable Waters;* by Mr. JEROME NICKLÈS.

THE berries of the privet (*Ligustrum vulgare*), which are often employed in Europe to color wines, contain, besides water and ligneous matter, a portion of glucose, a waxy substance and a beautiful crimson coloring matter, which is the principal element. This matter is soluble in water, alcohol and ether; it contains no nitrogen, and is much more stable than many allied substances. When exposed to a sufficient heat it gives a black porous charcoal, but the uncharred portions remain unchanged. It was not altered by boiling for forty-eight hours with distilled water, nor by digestion during six weeks with sulphurous acid. The fixed alkalies and their neutral carbonates turn its color to green, but the red is restored by acids so that it may be employed as a delicate test in place of litmus or the coloring matter of the dahlia. With a solution of acetate of alumina it gives a violet blue liquid, from which by boiling a fine blue lake is precipitated, which is insoluble in acetic acid, but dissolves in tartaric, citric and mineral acids to a red liquid, from which alkalies

throw down again the blue lake. The basic, and even the neutral acetate of lead, yield with the red coloring matter of the privet a blue precipitate, which is soluble in acetic acid. Ammonia readily alters this coloring matter, giving rise to a yellow substance not well defined in its character. From these observations it would appear that the red coloring principle of the berries of the privet is a substance *sui-generis* and distinct from any hitherto known. I therefore propose to designate it by the name of *liguline*.

In order to obtain liguline in a state of purity, the filtered juice of the berries was precipitated by neutral acetate of lead, and the well washed lake suspended in a small quantity of water was decomposed by sulphuretted hydrogen. The residue was then thoroughly washed by ether, in which the liguline is insoluble.* Being taken up by alcohol, and again treated by acetate of lead, sulphuretted hydrogen and ether, it might be supposed to be pure. I was, however, unable to obtain concordant results in a series of elementary analyses, the carbon of the direct lead compound varying between 21·56 and 23·00 per cent, and the hydrogen from 1·89 to 2·58.

It is probable that the process described by Mr. Glénard for the preparation of *oenoline*, the red coloring matter of wines (*An. de Chim. et de Phys.*, Dec. 1858, p. 368), would be preferable for the extraction of liguline. I accordingly applied it, but the berries having been gathered too late in the season, the coloring matter had become so far altered that my trial was unsuccessful, so that the question of the elementary composition of liguline remains unsettled.

The following further observations on this coloring matter are not without interest. It is not precipitated by gelatine, which throws down the red coloring matter of wines. With hypochlorite of lime it gives a yellow color and a yellow precipitate. With chlorid of gold, a yellow color and reduction of the metal. With chlorid of platinum, no change in the cold, but a brown color by heat. With chromate of potash a green; with bichromate brown, and with sesquichlorid, and ferroso-ferric sulphate of iron the same color. Chlorine destroys the color of liguline. The chlorids of sodium, barium and mercury, the nitrates of baryta, lead, mercury and bismuth, as also the sulphates of starch, soda, lime, zinc, manganese and cadmium are without action on the coloring matter of the privet.

The bicarbonates of lime and of the alkalies (unlike the neutral alkaline carbonates which turn it to green) give a blue color with liguline, and the same is true of the chlorids and nitrates of zinc and calcium. The colors thus obtained offer however some

* The author has previously stated that the coloring matter is soluble in ether—there is apparently some error of the copyist.—Note of the Translator.

peculiar differences when seen by transmitted light; in this way the blue produced by a chlorid of zinc and bicarbonate of lime appears red, while it is green with the chlorid of calcium or the nitrate of lime or zinc. The blue color produced by a solution of bicarbonate of potash, on the contrary, offers no variation when thus viewed by transmitted light.

The recent juice of the berries of privet alters readily even when mixed with alcohol; its fine crimson color turns to red, and the liquid then mingled with a solution of bicarbonate of lime gives a gray instead of a blue color, and gives a dirty blue with acetate of lead. This change appears to depend upon the development of ammonia from the transformation of the azotized matter of the juice; when separated from these matters and isolated, on the contrary, liguline may be preserved without change, either in aqueous or alcoholic solution. Its color is then an intense crimson.

Even the strong mineral acids in the cold do not alter liguline, but in the presence of alkalies on the contrary, it is rapidly altered, although the red color can be, to a certain extent, restored by an acid. This alteration is dependent upon the absorption of oxygen, as may be shown by introducing a mixture of liguline and potash ley in a glass tube over mercury, when rapid absorption takes place.

The property of liguline to produce blue with solutions of bicarbonate of lime renders it a delicate reagent for the detection of this salt in potable waters. For this purpose it suffices to let fall a drop of an aqueous or alcoholic solution of liguline into the water, the crimson tint which this communicates to distilled water is replaced by a beautiful blue. In place of the solution we may employ a test paper impregnated with the coloring matter, which is best as prepared from the lead precipitate. We may, however, employ the recent juice of the berries, taking care to redden the paper slightly by exposing it to the vapor of acetic acid before drying.

As a reagent for the detection of bicarbonate of lime in waters, liguline is greatly to be preferred to a tincture of logwood, and the paper prepared with it becomes a valuable reagent for the laboratory as well as for the naturalist in the field. I have found by this reagent that while bicarbonate of lime is indicated in the springs which flow from the jurassic strata, and especially those that supply the city of Nancy, no change of color is produced by a solution of liguline with the waters of other streams which have their source in rocks destitute of calcareous matter.

The observations which I have given above were made for the most part with the fruit of the privet gathered in the autumn of 1856, and I have in fact indicated in a note in the Bulletin of the local Society of Acclimation for the North-West district

(Nancy, 1857, p. 121). I have delayed publication in the hope to render my research more complete by a good elementary analysis, but I am now induced to publish the results already obtained that I may claim the right to continue and complete the investigations, having learned that Mr. Glenard proposes to undertake a similar research.

In conclusion, we may remark that the coloring matter of the privet offers a great analogy with that of the wines of Villefranche isolated and examined by Mr. Glenard; this analogy is shown by their composition and their properties. Its reaction with bicarbonate of lime may render it a valuable reagent in chemical analysis. The fact that it is not precipitated by gelatine, which, as is well known, throws down the red coloring matter of wines, will serve to distinguish the two when associated. It still remains to be decided whether the coloring principle of all red wines is the same, but this is a question foreign to our present subject.

ART. XXVIII.—*On the Method of Measurements, as a diagnostic means of distinguishing Human Races, adopted by Drs. Scherzer and Schwarz, in the Austrian circumnavigatory Expedition of the "Novara";* by JOSEPH BARNARD DAVIS.

WEIGHT and measure have been very frequently applied as means to determine the physical proportions of different human races, and to ascertain their essential diversities. But it may well be doubted whether they have ever been employed in that systematic and comprehensive manner, which will afford the results they are capable of yielding. Travellers have generally contented themselves by speaking in indefinite comparative terms of the people with whom they have come into contact. But few have submitted any considerable number of these people to the test of measurement, and thus ascertained their dimensions. Anthropology stands in need of many more accurate and extended observations, to derive the full results from these sources of knowledge.

The subject itself is a large one, and some have confined themselves to one branch of it, some to others. Where actual measurements have been carried out, many have contented themselves with taking the *stature* of a few, or a number, of the people; others have, besides, ascertained the length of the *limbs;* and a few have subjected the *head* to a series of superficial measurements. As we are fully assured that this latter division of

the body is the seat of those faculties which lie at the base of all the peculiarities of human races; bearing essentially and intimately upon their manners and customs, all their institutions, their religious impulses; their capacity for civilization, and the development to which it has attained, it is not surprising that it should have attracted the chiefest attention. Besides the superficial measurements of the head, a more extensive series of observations has been made upon the bony skull itself, with a view of determining its relative proportions, for comparison in the same race, or among different races. Many observers, advancing a step nearer, have endeavored to ascertain, by measure and by weight, the *internal capacity* of this marble palace. And, lastly, some have laboriously devoted their inquiries to the great central mass of the nervous system, and availed themselves of the opportunities that have occurred to them, to determine the size and the weight of the brain, and its different parts. As this last investigation comes nearest of all to the specialties of human beings—who are so finely discriminated by Professor Owen, as *archencephala*—it is to be regretted that the occasions for research among distinct races are so few, and have been so little availed of, and the investigation itself is so elaborate and nice, that hitherto this most interesting part of anthropological anatomy is, as it were, a *tabula rasa*, to use the language of one of the most laborious inquirers in this branch of science—Prof. Huschke, of the University of Jena. It is, however, fortunate that gauging the internal capacity of the skull should afford the means of so accurate an approximation to the volume and the weight of the brain; and thus, for the comparison of these important points among the different families and tribes of men. Hence, the labors of Tiedemann, the distinguished physiologist, who, with a very amiable design, undertook to show that the brain of a negro was not smaller than that of the European—an attempt similar to that of the late Sir William Hamilton. Tiedemann might have succeeded in impressing us with his own conclusion, had he not published the tables on which this conclusion was based, and which themselves refute such an erroneous opinion. To Tiedemann succeeded Professor Morton, of Philadelphia, Professor Van der Hoeven, of Leyden, and others. Among the most recent, is Prof. Huschke, of Jena, one of whose results of whose own estimation of the capacity of the skull, and of the size of the brain, is, that the Germanic races, among whom through our Anglo-Saxon forefathers we rank, as one great branch, have the largest brains of any people. They distinctly exceed the French in this respect.

That great diversities, capable of metrical appreciation, prevail among human races is very well known. Some of the tribes of North American Indians are remarkable for their great stat-

ure. Catlin assures us that the men among the *Crows*, whose hair will frequently reach the calves of their legs, are most of them six feet or more. Other tribes are of a decidedly lower stature. Of the gigantic Patagonians of South America, the most extravagant accounts have been given by travellers. But Capt. King affirms them, upon measurement, to be from 5 feet 10 inches to 6 feet high, which is supported by the statement of M. D'Orbigny, that some are 6 ft. $3\frac{1}{2}$ inches, and the medium stature is above 5 ft. 8 inches English. On the contrary, the average height of the Bushmen is only 4 feet 4 inches. This gives a range of very nearly two feet between the tallest and the shortest races of men we are acquainted with. The other races of mankind are comprised within these limits of difference. Some tribes of the Negritos average about 4 feet 8 inches; the so-called Malay races, ascending to a mean of 5 feet 3 inches. But among the Negrito tribes of the Pacific there is, as that eminent ethnologist, Mr. Crawford, has clearly shown, a great diversity of stature. They dwell in islands scattered over a large extent of ocean, and although some tribes do not reach 5 feet in height, others, as those of New Caledonia, attain to 6 feet, and individuals among them even more. In the recent expeditions to the Andaman Islands, for the purpose of selecting a spot for a penal settlement, the inhabitants are spoken of as "dwarf Negrillos," and as "men of middle size." An individual who was measured, gave a stature of 4 feet $9\frac{1}{2}$ English inches. (Selections from the Records of the Government of India, No. xxv: the Andaman Islands.) Thus, in stature alone, a very great diversity prevails. And it is remarkable that tribes in close proximity to each other frequently exhibit startling contrasts. Dr. Livingstone, whose opportunities had he been an ethnologist were so extraordinary, observed in the plains of the interior of Southern Africa, scattered among the Kafirs, who are a tall, fine and robust race, the hordes of the diminutive Bushmen. He was deeply impressed with what he saw, so contrary to all his preconceptions; and expresses his great surprise that such dissimilar races should be everywhere scattered about the country without being mingled, where they have dwelt for unlimited ages, exposed to all the same influences of air, climate, food, &c. The tall Patagonians and some tribes of the Fuegians, distinguished for their dwarf stature, afford a similar example of contrast.

The brothers Schlagintweit, following in the train of Mr. Hodgson, carried on an extensive series of metrical observations on the tribes of the Himalaya and of India. Many curious results, chiefly pointing to the different proportions of parts of the bodies and limbs of these people from those of Europeans, have been attained, which will be published in the ethnological portion of their projected work. After ascertaining the weight of

the individual and his strength, by means of the dynamometer, they made from 25 to 28 different measurements, chiefly of the head, and of other parts of the body and limbs. But Drs. Scherzer and Schwarz have striven, by a more complex and complete system of observation and measurement, to gain an image of the size and form of the individual, and of all his parts;—thus not merely to subserve the purposes of the anatomist, the physiologist and the ethnologist, but those of the artist also. Their more ambitious object of obtaining, in this way, to a natural classification of human races, is an evidence of laudable zeal; but we can hardly hope that their labors can do more than contribute towards the solution of this difficult problem. Although, it ought to be mentioned, that the late Baron Humboldt, a short time before his death, expressed his great satisfaction with the system of measurements of Drs. Scherzer and Schwarz; by which, he thought, we may at length arrive at a safer result in distinguishing and determining human races than by any other means.

After recording the age, weight, height, strength, color of the hair and eyes, and number of the pulsations of the radial artery, they divide their measurements into three sections, those of the *head*, the *trunk*, and the *extremities;* and of these they take no less than 70 different dimensions in all, by means of different instruments.

Their external measurements of the head are the most complete that have ever been employed. They embrace the face as well as the other parts of the head, and by means of a perpendicular line with plummet, and a small metre scale, they are able to ascertain pretty correctly the profile of the countenance. The number of their different measurements of and about the *head*, consisting of superficial distances, diameters, circumferences, &c. amounts to 31, those of the *trunk* to 18, and those of the *extremities* to 21.

When the frigate "Novara" reached Sydney, these gentlemen printed an account of their system of measurements, "for private circulation" among men of science, which is preceded by a number of ingenious observations. In these, they dwell upon the ease with which travellers intuitively discriminate the different nations and tribes of mankind; and yet the difficulty in some selected individuals and cases to carry out this diagnosis, especially when the eye is deceived by a substitution of dress; and express great confidence in a more minute examination by a systematic method of measurements. They insist with equal confidence that nature must recognize a definite plan by which man's different types are formed and distinguished; and conclude that we should dedicate the same amount of study and inquiry to the systematic arrangement of our own species, as has

long been applied to thousands of species of the vegetable and animal kingdoms.

In the course of these introductory remarks they mention their examination of the Chinese inmates of the prison at Hong Kong. Among these they found persons belonging to the *Hakka Tribe*, with stout and vigorous constitutions, fine, well-shaped, aquiline or long and straight noses, and a form of the eyes not resembling the specific obliquity of other Chinese. As criminals, they had been deprived of their tails, and Drs. Scherzer and Schwarz affirm that they had such a resemblance to the figures of some Europeans of the lower class, that, by a change of dress, they might pass amongst us without being recognized. They also mention how successfully Gützlaff, Medhurst, Huc and others have travelled the Empire in a Chinese dress without detection. And, no doubt, there are individuals so capable of assuming, and, as it were, substituting, the manners and expressions of others that the ordinary and slight attention which is paid to persons on a journey and among numbers, does not suffice to discriminate them.

Still, *the rule* must run counter to such a confusion; or the statement of the Austrian voyagers could not be true—that an anthropologist on the Island of Java is able, at first view, to classify most of the Malay tribes inhabiting the larger and smaller Islands on the Indian Archipelago, without ever mistaking. And the very remarkable account of the Abbé Huc proves that if there are differences among the races of men too subtle to be detected by the eye, yet they are not the less certainly appreciable. He informs us that he and his companion successfully eluded the detection of the unsuspecting or inattentive Chinese, but that to the Chinese *dogs* they always stood at once revealed as Europeans, by their peculiar smell. "The dogs barked continually at us, and appeared to know that we were foreigners." This is not the proper time to refer to the distinguishable odors of the different races of mankind, which travellers allude to. Huc said he could easily distinguish those of the Negro, the Malay, the Tartar, the Thibetan, the Hindoo, the Arab and the Chinese. Indeed, it is the same, with those having a delicate sense of smell, as to the French and other European races. And with respect to the fact of the penetrating and offensive scent attached to man, more especially to civilized man, Mr. Galton and others, who have traversed desert countries teeming with wild animals, give distinct and prominent testimony—which testimony is, in truth, not very complimentary to us.

We have been informed, on the authority of one who has seen much of the North American Indians, that they describe an odor to them peculiarly disgusting as being attached to the Jews. A fact, which, if correct, is little accordant with the ex-

traordinary hypotheses which would derive the Indians themselves from the lost tribes.

Finally, it may be mentioned, that by a recent communication from Dr. Scherzer we are informed that during the cruise of the "Novara," about 200 individuals of different races, but of about the same age, males and females, were subjected to measurement. The whole number of measures taken amount to nearly 12,000. Dr. Scherzer adds, that he does not consider these observations sufficient, but merely as a commencement of a system of thorough metrical examination;—that the paper on measurements has been translated into different languages, and copies of it left in the hands of physicians, and other men of science, in the different places and islands visited by the expedition, who promised to complete the observations on the aborigines, and to forward the results to Europe;—that the measurements already effected embrace those made on Negroes, Malays, Mongols, Papuans and Indians;—and that the greatest number were taken on individuals in the Nicobar Islands, Batavia, where natives of almost all the islands of the Indian Archipelago were met with; Manilla, Hong Kong, Sydney (Austral negroes), New Zealand, Tahiti (where were aborigines of New Caledonia and Norfolk Island), Chili and Peru.

The results obtained by the extensive series of measurements thus procured, will shortly be published to the world, in the volumes now in preparation at Vienna. The History of the important Voyage of the "Novara," a popular illustrated work, from the Journals of the Commanders, Commodore Wüllustorf and Dr. Scherzer, may be expected to be issued from the Imperial printing office, in Vienna, to be followed by an English translation, in the early part of the present year. It is proposed that this shall be succeeded by a number of other volumes on distinct subjects. 1. Those on nautical, astronomical, meteorological, magnetical, and other observations relating to Physical Geography, by Commodore Wüllustorf. 2. Geology, by Dr. Hochstetter. 3. Zoology, by Messrs. Frauenfeld and Zelebor. 5. Ethnography, by Dr. Scherzer. 6. Statistics and Natural Economy, by the same. 7. Medicine, (Pathological and Pharmacognostical Researches,) by Dr. Schwarz. And, lastly, 8. an Album selected from nearly 2,500 sketches made by Mr. Sellery, the artist of the expedition. Whenever this grand programme, which will have the best wishes of men of science in all countries, shall have been completed, the rich results of the first Austrian Circumnavigatory Expedition, placed as it has been in able and well instructed hands, will, we have no doubt, vindicate the national character in a new and much nobler field of enterprise; and give to that country a far more lasting and more dignified fame than any she has hitherto required.

Note.—Such is the inconvenience resulting from the use of a variety of metre scales, and such a number of methods of measurement, frequently taking quite different points for measures bearing the same name, as in the case of the skull especially, that the distinguished Professor Von Bær, of St. Petersburg, has just proposed a Congress of Anthropologists, to determine upon one uniform scale and to establish one system. By this means, all the results of measurements of the human body would be rendered of universal applicability.—*Nachrichten über die ethnog. craniol. Sammlung zu St. Petersburg. S.* 81.

ART. XXIX.—*Report of Assistant Charles A. Schott, on the latest results of the Discussion of the Secular Change of the Magnetic Declination, accompanied by tables showing the declination (variation of the needle) for every tenth year from the date of the earliest reliable observations, for twenty-six stations on the Atlantic, Gulf, and Pacific coasts of the United States.*

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IN accordance with the Superintendent's letter of January 21, 1859, I have prepared a set of tables for practical use, giving the secular change of the magnetic declination and showing for every tenth year, from the date of the earliest reliable observations to the present time, the magnetic declination (commonly called the variation of the magnetic needle) for stations on or near the northeastern coast of the United States and also for some stations on our southern and western coasts—as derived from my several discussions of the secular change in which have been included the latest data in possession of the Coast Survey. For the eastern and southern coasts, the following papers may be referred to: Coast Survey report for 1855, Appendix No. 48, pp. 306–337; Coast Survey report for 1858, Appendix No. 25, pp. 192–195, and Appendix No. 26, pp. 195–197. For the western coast, Coast Survey report for 1856, Appendix No. 31, pp. 228–235 may be consulted.

In general the secular change of the declination appears to be of a periodic character, but in no instance has a whole cycle been completed on either coast. Its length therefore remains necessarily in a great measure uncertain, and the tentative analytical process so far followed has for its main object the proper representation of all reliable observations made at any one station, so as to furnish the means of interpolation and also to enable us to calculate the magnetic declination for any required place and date, within the limits of the discussion. In the in-

vestigation of 1855 a linear function was used in the discussion which does not involve the duration of the period, and on this account the results were, in regard to time, of rather limited extent (see remark on p. 337 of Report for 1855). For the western coast stations, I still prefer to retain this form of the discussion. Subsequently, by means of the knowledge gained in that discussion, an attempt was made to substitute a circular function, directly involving a period or periods, the length of which, as well as all other numerical co-efficients in the formula for the secular change, has been determined by applying the method of least squares. The use of a circular function—commenced in 1858 with two stations, is now extended to eighteen, within the limits stated above, and it has been applied to some stations in Canada, the southern coast of the United States and Central America, in order to furnish material for the generalization of the law, so far as ascertained, in reference to epochs and rates of change. A secondary period within the first was traced at several stations, its length, however, being much more variable and uncertain, was found fluctuating between one-half and one-fifth of the primary period, while its amplitude was on the average fifteen times smaller than that of the primary wave for stations forming group 1, or within the geographical limits of Portland, Burlington and Williamsburg. This smaller amplitude was found nearly constant and equal to $0^{\circ}.4$.

To make the present paper more complete it contains also the record of all observations used in the discussion not heretofore published in the Coast Survey reports.

As long as the cause producing the secular change remains altogether unknown, it is not safe to trust too far to the continuation of the law thus empirically derived, and in the following tables no value, deduced by the formula, has been inserted antecedent to the first observation by more than ten years. The tabular values may therefore be regarded in the light of a strict interpolation between actual observations, and since the analytical treatment will equalize and remove, in a measure, accidental errors of observation, they may be considered as certainly more trustworthy than any single observation, particularly in cases where the number of observations available for the discussion exceeds half a dozen, properly distributed in relation to time. The probable error of any single representation will be found in the second table. For all ordinary use by the surveyor (or navigator) the tabular values are sufficiently precise, when greater accuracy is required the annual inequality of the declination and the diurnal variation for the time required must be taken into account; the former correction will probably not exceed, in any case, one minute, and the latter may amount in summer, in maximo, to minus or plus six minutes, and in winter to

minus or plus three minutes, numbers which were derived from Prof. Bache's discussion of the Philadelphia observations. The tables will also answer for intermediate places, for which they furnish the necessary data of interpolation.

It is proper to state that the present formulæ should be considered as liable to future changes and improvements depending on the accumulation of additional observations, and it is hardly necessary to state that their number also may hereafter be considerably increased by the accession of new material. The utility of a publication of tables showing the declination for every tenth year was suggested by Mr. T. B. Brooks. In the numerical calculations I was assisted by Mr. G. Rumpf of the Computing Division.

Formulæ expressing the secular change of the magnetic declination (commonly called variation of the magnetic needle) used for calculating the tabular values.—Group 1. Stations between Portland, Me., and Williamsburg, Va.

A positive sign of D indicates west declination, a negative sign, east declination. n equals the number of years (and fraction of a year) from 1830; positive for years after and negative for years before this epoch. Longitudes are reckoned from Greenwich.

No.	Locality.	Lat.	Long.	
1	Burlington, Vt.	44° 27′	73° 10′	$D=+11'.55-4'.10\cos(1°.30n+36°)+0°.21\cos(7°.2n+290°)$
2	Portland, Me.	43 39	70 16	$D=+10'.70-2'.63\cos(1°.33n+87°)$
3	Portsmouth, N. H.	43 05	70 43	$D=+10'.20-2'.45\cos(1°.37n+72°)$
4	Rutland, Vt.	43 36	72 55	$D=+\ 9'.89-3'.66\cos(1°.5n+45°)$
5	Cambridge, Mass.	42 23	71 07	$D=+\ 9'.65-2'.78\cos(1°.30n+71°)+0'.22\cos(2°.7n+220°)$
6	Newburyport, Ms.	42 48	70 49	$D=+\ 9'.55-2'.56\cos(1°.4n+78°)$
7	Boston,	42 20	71 02	$D=+\ 9'.16-2'.55\cos(1°.39n+76°)+0'.22\cos(3°.6n+222°)$
8	Providence, R. I.	41 50	71 24	$D=+\ 9'.11-2'.99\cos(1°.45n+58°)+0'.19\cos(7°.2n+246°)$
9	Hartford, Conn.	41 46	72 40	$D=+\ 8'.60-3'.59\cos(1°.25n+45°)$
10	New Haven, Conn.	41 17	72 55	$D=+\ 8'.13-3'.49\cos(1°.33n+39°)$
11	Albany, N. Y.	42 39	73 43	$D=+\ 7'.65-2'.74\cos(1°.42n+62°)$
12	Oxford, N. Y.	42 27	75 42	$D=+\ 6'.65-3'.69\cos(1°.3n+40°)$
13	New York,	40 43	74 00	$D=+\ 6'.47-2'.32\cos(1°.6n+55°)$
14	Philadelphia,	39 58	75 10	$D=+\ 5'.37-3'.44\cos(1°.6n+39°)$
15	Hatboro', Pa.	40 07	75 08	$D=+\ 5'.23-3'.28\cos(1°.54n+47°)+0'.22\cos(4°.1n+347°)$
16	Baltimore,	39 16	76 35	$D=+\ 2'.70-2'.25\cos(1°.5n+49°)$
17	Washington, D. C.	38 53	77 00	$D=+\ 2'.42-2'.0\cos(1°.5n+49°)$
18	Williamsburg, Va.	37 15	76 40	$D=+\ 2'.22-2'.6\cos(1°.5n+22°)$

The following table contains the number (n) of observations (single or combined) upon which each formula is based; the probable error (E_o) of an observation expressed in minutes, as a measure of the degree of accuracy with which the observations are represented; the epoch of the last minimum of west declination (or of maximum east declination) together with the least west declination (greatest east), and lastly, the annual variation

for the years 1840, 1850, and 1860, expressed in minutes. The positive sign expresses west declination increasing (east diminishing).

Locality.	n	E_0	Epoch of min. W. decl'n.	Least W. decl'n	Annual change.		
					ϑ1840	ϑ1850	ϑ1860
		′		°	′	′	′
Burlington, Vt.	9	± 5	1813	+7·4	+4·1	+3·4	+4·5
Portland, Me.	5	14	1765	+8·1	+3·6	+3·4	+3·0
Portsmouth, N. H.	4	10	1777	+7·7	+3·5	+3·5	+3·2
Rutland, Vt.	4	18	1800	+6·2	+4·9	+5·5	+5·7
Cambridge, Mass.	22	12	1782	+6·9	+4·3	+4·3	....
Newburyport, Mass.	4	12	1774	+7·0	+3·7	+3·6	+3·3
Boston,	8	10	1782	+6·7	+4·5	+4·3	+3·7
Providence, R. I.	30	5	1779	+6·1	+5·3	+3·8	+3·0
Hartford, Conn.	6	14	1794	+5·0	+4·0	+4·4	+4·6
New Haven,	14	10	1801	+4·6	+3·8	+4·4	+4·7
Albany, N. Y.	10	3	1787	+4·9	+3·9	+4·0	+3·9
Oxford, N. Y.	10	11	1799	+3·0	+4·0	+4·6	+4·9
New York,	13	13	1795	+4·1	+3·7	+3·9	+2·8
Philadelphia,	11	16	1805	+1·9	+4·7	+5·3	+5·4
Hatboro, Pa.	18	5	1796	+1·8	+4·2	+4·3	+4·4
Baltimore,	3	13	1798	+0·5	+3·2	+3·4	+3·4
Washington, D. C.	6	8	1798	+0·4	+2·8	+3·1	+3·1
Williamsburg, Va.	3	15	1815	-0·4	+2·4	+3·2	+3·7

Table of magnetic declinations for eighteen stations forming group 1, *on or near the northeastern coast of the United States, between the years* 1680 *and* 1860. *West declination is indicated by a plus sign, east declination by a minus sign, and is expressed in degrees and fractions of a degree.*

Year.	Burlington, Vt.	Portland, Me.	Portsmouth, N. H.	Rutland, Vt.	Cambridge, Mass.	Newburyport, Mass.	Boston.	Providence, R. I.	Hartford, Conn.
	°	°	°	°	°	°	°	°	°
1680	.....	.....	.....	.....	.....	.....	.....	.....	.....
1690	.....	.....	.....	.....	.....	.....	.....	.....	.....
1700	.....	.....	.....	.....	+ 9·9	.....	+ 9·7	.....	.....
1710	.....	.....	.....	.....	9·4	.....	9·0	+10·4	.....
1720	.....	.....	.....	.....	8·8	.....	8·3	9·5	.....
1730	.....	.....	.....	.....	8·4	.....	7·8	8·9	.....
1740	.....	.....	.....	.....	7·9	.....	7·4	8·3	.....
1750	.....	.....	.....	.....	7·5	.....	7·2	7·7	.....
1760	.....	+ 8·1	.....	.....	7·2	.....	7·0	6·9	.....
1770	.....	8·1	+ 7·8	.....	7·0	+ 7·0	6·8	6·3	.....
1780	.....	8·3	7·7	.....	6·9	7·0	6·8	6·1	+5·2
1790	+ 7·8	8·5	7·9	+6·3	6·9	7·2	6·8	6·3	5·0
1800	7·5	8·9	8·1	6·2	7·1	7·5	7·0	6·4	5·0
1810	7·3	9·4	8·5	6·3	7·5	7·9	7·3	6·5	5·2
1820	7·6	10·0	8·9	6·7	8·0	8·4	7·8	6·8	5·6
1830	8·30	10·6	9·4	7·3	8·58	9·0	8·41	7·46	6·1
1840	9·07	11·2	10·0	8·1	9·28	9·6	9·13	8·38	6·7
1850	9·69	11·8	10·6	8·9	10·0	10·3	9·88	9·14	7·4
1860	+10·30	+12·3	+11·2	+9·9	+.....	+10·8	+10·56	+ 9·68	+8·1

Year.	New Haven, Conn.	Albany, N. Y.	Oxford, N. Y.	New York.	Philadelphia.	Hatboro', Pa.	Baltimore.	Washington, D. C.	Williamsburg, Va.
	°	°	°	°	°	°	°	°	°
1680	.....	.....	.....	+8·8	.....	+8·5	.....	.....	.....
1690	.....	.....	.....	8·7	.....	8·3	.....	.....	+4·8
1700	.....	.....	.....	8·5	+8·8	7·9	.....	.....	+4·8
1710	.....	.....	.....	8·0	8·4	7·5	.....	.....	.....
1720	.....	.....	.....	7·6	7·9	7·0	.....	.....	.....
1730	.....	.....	.....	7·0	7·1	6·3	.....	.....	.....
1740	.....	.....	.....	6·4	6·3	5·6	.....	.....	.....
1750	.....	.....	.....	5·8	5·3	4·7	.....	.....	.....
1760	+6·1	.....	.....	5·2	4·4	3·8	.....	.....	.....
1770	5·5	.....	.....	4·7	3·5	2·9	.....	.....	+1·2
1780	5·0	.....	.....	4·4	2·8	2·2	.....	.....	+0·7
1790	4·8	.....	+3·0	4·2	2·2	1·8	.....	.....	+0·2
1800	4·6	.....	3·0	4·2	2·0	1·8	.....	+0·4	−0·2
1810	4·7	+5·4	3·1	4·3	1·9	2·1	+0·6	0·5	−0·4
1820	5·0	5·8	3·4	4·7	2·2	2·6	0·8	0·8	−0·4
1830	5·42	6·3	3·82	5·16	2·70	3·20	1·2	1·1	−0·2
1840	5·98	7·0	4·43	5·73	3·41	3·89	1·7	1·5	+0·1
1850	6·71	7·7	5·15	6·37	4·25	4·61	2·4	2·0	+0·6
1860	+7·46	+8·3	+5·95	+7·01	+5·19	+5·32	+2·9	+2·6	+1·2

Note.—At Cambridge, Mass., the observations after 1855 require farther examination. At Williamsburg, the values between 1700 and 1770 were not considered sufficiently reliable for insertion. The expression for Baltimore depends for length of period and time of minimum on the Washington formula.

The total number of observations upon which the tabular values and the formulæ are based is 180, the average number of any one station is 10, and the average probable error of any single representation is $\pm 11'$.

If we arrange the stations geographically, we find that at the eastern stations the minimum (west) declination occurred earlier than at the more western and southern stations; thus, from six stations between Portland and Providence it occurred about the year 1777; in the Connecticut and Hudson valleys and along the sea-coast as far south as Washington, the year of the minimum does not differ much from 1797; Williamsburg in Virginia gives 1815. The transition as we pass from the New England states is somewhat abrupt, but too well marked to be accidental. Extending the investigation farther north, I find for Quebec, Canada, the year of the minimum 1769; going farther west we find that at Toronto it must have occurred before the year 1842, and at York Fort, Hudson Bay, I find the year 1842 (as already ascertained by General Sabine, after the receipt of Capt. Blakiston's observations of 1857). This latter station is nearly halfway across the continent, and if we proceed to the western coast we find that the eastern declination there has not yet reached its maximum (equivalent to a western minimum), but it is highly probable that it will reach it before the close of the

present century. The present reverse or western motion of the isogonic lines in our eastern states which commenced about the year 1777 will gradually be communicated to the more westerly stations, and will, it is highly probable, be participated in our western coast before or at the close of the present century, the direction of the motion in this latter locality being at present still to the eastward and southward, though with a diminishing rate (see p. 235 of C. S. report of 1856).

The following equations constructed for the two northernmost stations may be added here:

York Fort, Hudson Bay, $D=+\ 5°{\cdot}1\ -14°{\cdot}2\cos(1°{\cdot}6n+340°)$
Quebec, Canada, $D=+12\ {\cdot}84-\ 3\ {\cdot}7\cos(1\ {\cdot}6n+\ 97\ )$

The second group comprises the stations on the southern portion of the Atlantic coast and Gulf coast; only three in number, to which have been added some stations located further south.

Group II. *Southern Stations.*

No.	Locality.	Lat.	Long.	Magnetic declination.
1	Charleston, S. C.	32° 45′	79° 51′	$D=-2°{\cdot}12-2°{\cdot}02\cos(1°{\cdot}55n+56°)$
2	Savannah, Ga.	32 05	81 05	$D=-2{\cdot}95-1{\cdot}24\cos(1{\cdot}5n+20)$
3	Mobile, Ala.	30 41	88 02	$D=-6{\cdot}5\ -0{\cdot}77\cos(1{\cdot}6n+16)$

Locality.	n	E_0	Epoch of max. east declination.	Max. east declination	Annual change.		
					1840	1850	1860
Charleston, S. C.	5	± 9′	1794	−4°·1	+3′·1	+3′·2	+3′·2
Savannah, Ga.	4	12	1817	−4·2	+1·1	+1·5	+1·8
Mobile, Ala.	6	12	1820	−7·3	+0·7	+0·9	+1·1

Proceeding in a southerly direction the next station discussed outside of the boundaries of the United States is Havana, Cuba, lat. 23° 09′, long. 82° 22′, for which place I found $D=-4°{\cdot}82-1{\cdot}45\cos(1{\cdot}3n+26°)$ with 1810 as the year of maximum east declination. The values collected for Jamaica were not discussed, but the nine values I was able to obtain, will be found in the appended record. For Panama, New Granada, lat. +8° 57′, long. 79° 29′, the southernmost station discussed, I find $D=-6°{\cdot}9-1°{\cdot}04\cos(1{\cdot}2n+74°)$, an equation satisfying the observations, but not considered as preferable to the following expression, $D=-5°{\cdot}57-2°{\cdot}21\cos(1{\cdot}2n+34°)$, which supposes the maximum to occur in 1802.

Going westward and northward I found for Vera Cruz, Mexico, lat. 19° 12′, long. 96° 09′, $D=-4°{\cdot}2-5{\cdot}04\cos(1{\cdot}1n+7°)$, with the maximum east declination in 1824.

The following table has been calculated from the preceding equations:

Year.	Charleston, S. C.	Savannah, Ga.	Mobile, Ala.
	°	°	°
1770	−3·7	....	....
1780	−4·0	....	....
1790	−4·1	....	....
1800	−4·1	−4·1	−7·1
1810	−4·0	−4·2	−7·2
1820	−3·6	−4·2	−7·3
1830	−3·2	−4·1	−7·2
1840	−2·8	−4·0	−7·1
1850	−2·2	−3·7	−7·0
1860	−1·7	−3·5	−6·8

The following formulæ for stations of the western coast, between San Diego and Cape Disappointment, forming group 3, have been copied from p. 234 of the report for 1856.

No.	Locality.	Lat.	[Long.]	
		° ′	° ′	
1	San Diego,	32 42	117 13	$D=-12\,17-0{\cdot}019n+0{\cdot}00018n^2$
2	Monterey,	36 38	121 54	$D=-14{\cdot}19-0{\cdot}050n+0{\cdot}00047n^2$
3	San Francisco,	37 48	122 27	$D=-15{\cdot}14-0{\cdot}028n+0{\cdot}00025n^2$
4	Cape Mendocino,	40 25	124 22	$D=-16{\cdot}29-0{\cdot}029n$
5	Cape Disappointment,	46 17	124 02	$D=-19{\cdot}65-0{\cdot}019n$

The total number of observations used for the construction of the above formulæ is 21, the greatest number for any one station being 6, the least 3, the average probable error of any single representation is ±12′. The annual change (increasing east declination) may be taken the same for all stations, viz., in 1840, −1′·6, in 1850, −1′·2, in 1860, −0′·8.

Year.	San Diego.	Monterey.	San Francisco.	Cape Mendocino.	Cape Disappointment.
	°	°	°	°	°
1790	−11·1	−11·4	−13·6	−15·1	−18·9
1800	11·4	12·3	14·1	15·4	19·1
1810	11·7	13·0	14·5	15·7	19·3
1820	12·0	13·6	14·8	16·0	19·5
1830	12·2	14·2	15·1	16·3	19·7
1840	12·3	14·6	15·4	16·6	19·8
1850	12·5	15·0	15·6	16·9	20·0
1860	−12·6	−15·3	−15·8	−17·2	−20·2

The next station discussed, south of California, is San Blas, Mexico, lat. 21° 32′ N., long. 105° 16′ W. of Gr., which gave the following expression (see p. 234, C. S. report for 1856),

$$D=-8°{\cdot}63-0{\cdot}042n-0{\cdot}00031n^2,$$

which equation, when compared with those above, shows a reversal in the sign of the coefficient of n^2 or an opposite curvature. The annual easterly increase at San Blas in 1850 according to the above formula was 3′·3. This station, however, is already within the area of the peculiar form of the isogonic lines, which position may possibly render an immediate compar-

ison impracticable. The station Sitka, in Russian America, is the next place discussed north of Washington Territory. I find for it the approximate formula,

$$D = -28°{\cdot}12 - 0{\cdot}0607n - 0{\cdot}00025n^2.$$

It depends for its latest declination (1858) on the tabular value assigned by Mr. Evans on his late map of the lines of equal magnetic variation reduced to 1858.

Record of all observed declinations made use of in the above paper, not heretofore published in the U. S. Coast Survey reports.

The following record, containing only additional observations, we have to consult the preceding reports of 1854,* 1855–'56, and '58, if we desire to collect all results which may have been used at any one station. The stations are arranged geographically, commencing with the northern and eastern stations and concluding with the stations on the western coast. D= observed declination.

York Fort, Hudson Bay.

From the Proceedings of the Royal Society of London for January 7, 1858, by Major Gen. Sabine.

1725,	D=19° 00′ W.		Capt. Middleton.
1787,	5 00 "		Hansteen's map.
1819, Sept.,	6 00 E.		Sir J. Franklin.
1843, July,	9 25 "		Capt. Lefroy.
1857, Aug.,	7 37 "		Capt. Blakiston.

Quebec, Canada.

1649,	D=16° 00′ W.	P. Bressau, Hansteen's Erdmag's, Barlow Cycl. Met.
1686,	15 30 "	DeHayes, " " "
1810,	11 00 "	Becquerel, traité du magnetisme.
1814,	11 50 "	Kent, Becquerel traité du magnetisme.
1831,	13 38 "	Bayfield, " " " "
1842,	14 12 "	Capt. Lefroy.
1859, July,	16 17 "	Chas. A. Schott, Asst. U. S. Coast Survey.

Burlington, Vt.

See former observations in 1855 report, pp. 326–337.

1837,	D= 8° 45′ W.		Prof. Benedict.
1840,	9 42 "		J. Johnson, Thompson's Hist. of Vermont.
1845, June,	9 22 "		Dr. J. Locke, Smiths. Contrib. to Knowledge, vol. iii, 1852.

Portland, Me.

1763,	D= 7° 45′ W.	J. Winthrop, Sill.'s Journal, xxxiv, 1838, Prof. Loomis's collection.
1775,	8 30 "	J. F. DeBarre's Atlantic Neptune, London, 1781.

* The table of the declinations in that report is reprinted and enlarged in the report of 1855.

1845, June,		11	28 "	Dr. J. Locke, Smiths. Contrib. to Knowledge, vol. iii, 1852.
1859, July,		12	20 "	Chás. A. Schott, Asst. U. S. Coast Survey.

See also C. S. report of 1856, p. 215.

Portsmouth, N. H.

1771,	*D*=	7°	46′ W.	Holland, Sill.'s Journal, xxxiv, 1838, Prof. Loomis's collection.
1771,		7	48 "	Holland.
1775,		7	45 "	J. F. DeBarre's Atlantic Neptune.
1859, July,		11	15 "	Chas. A. Schott, Asst. U. S. Coast Survey.

See also C. S. report of 1856, p. 215.

Rutland, Vt.

1789, April,	*D*=	7°	03′ W.	Dr. Williams, Sill.'s Journal, xvi, 1829.
1810, May,		6	04 "	" " " " " "
1811, Sept.,		6	01 "	" " " " " "
1859, July,		9	49 "	Chas. A. Schott, Asst. U. S. Coast Survey.

Cambridge, Mass.

See pp. 317–318 of C. S. report of 1855, also C. S. report, 1856, p. 222.

1845, June,	*D*=	9°	32′ W.	Dr. J. Locke, Smiths. Contrib. to Knowledge, vol. iii, 1852.
1855, May,		10	54·6 "	W. C. Bond (in a letter to Supt. of C. S.)
1856, May,		10	50·3 "	" " " "
1856, July,		10	06 "	Karl Friesach, Imp. Acad. of Sciences, Vienna, vol. xxix, 1858.

Note.—More recent observations still require examination.

Newburyport, Mass.

1775,	*D*=	6°	45′ W.	J. F. W. DeBarre's Atlantic Neptune.
1781,		7	18 "	Dr. Williams, Sill.'s Journal, xxxiv, 1838, Prof. Loomis's collection.
1859, July,		10	58 "	Chas. A. Schott, Asst. U. S. Coast Survey.

See also C. S. report, 1856, p. 215.

Boston, Mass.

See C. S. report, 1855, pp. 316, 317–337.

Providence, R. I.

See C. S. report, 1855, pp. 307, 308, 309, 337.

Hartford, Conn.

1786,	*D*=	5°	25′ W.	Dr. Williams,
1810,		4	46 "	Asher Miller,
1824,		5	45 "	N. Goodwin,
1828,		6	03 "	"
1829,		6	03 "	"

} Prof. Loomis's collection in Sill.'s Journal, vol. xxxiv, 1838.

1859, July,		8	04 "	An interpolated value from observations at Springfield and New Haven in 1859 and 1855.

New Haven, Conn.

See C. S. report, 1855, pp. 319, 320, 337.

Albany, N. Y.

1847, Nov.,	*D*=	7°	35′ W.	Regent's report (geological survey).

1856, Sept.,		8 35	"	Karl Friesach, Imp. Acad. of Sciences, Vienna, vol. xxix, 1858.

See also C. S. report, 1855, pp. 328–337, and C. S. report, 1858, p. 191.

Oxford, N. Y.

The following observations marked E. B. W. C. are from a letter of Mr. E. B. W. Call to the Superintendent C. S. Dec. 22, 1858.

1792–95,	$D=$	3° 00′	W.	E. B. W. C.
1817,		3 00	"	"
1828, July,		4 30	"	"
1834, Oct.,		3 52	"	Regent's report, Sill.'s Jour., xxxiv, 1838.
1836, Oct.,		4 09	"	" " " " "
1838, July,		4 30	"	" " observed at Guilford.
1849, Nov.,		5 11	"	E. B. W. C.
1857, April,		5 44	"	"
1858, Feb.,		5 47	"	"
1858, Dec.,		5 50	"	"

New York.

See C. S. report of 1855, pp. 320, 321, 333, and 337, also C. S. report, 1856, p. 217.

Philadelphia.

See C. S. report of 1855, pp. 313, 314, and 337.

Hatboro', Pa.

See C. S. report of 1858, pp. 192, 193, 194, and 195.

Baltimore, Md.

1808,	$D=$	0° 10′ to 15′	W.	D. Byrnes, vol. xviii, 1830, Sill.'s Journal.

See also C. S. report, 1856, pp. 219, 227, also C. S. report, 1858, p. 191.

Washington, D. C.

See C. S. report, 1858, pp. 195, 196, 197.

Williamsburg, Va.

1694,	$D=$	5° 00′	W.	Sill.'s Journal, vol. xxxiv, 1838, Prof. Loomis's collection.
1780,		0 50	"	" " " " "
1809,		0 33	E.	" " " " "
1856, Aug.,		1 04	W.	Deduced from observations at Petersburg, Old Point Comfort, and Norfolk.

Charleston, S. C.

1857, April,	$D=$	1° 56′	E.	Derived from observations at Savannah in 1852 and 1857.

See C. S. report, 1855, pp. 322, 323.

Savannah, Ga.

1817,	$D=$	4° 00′	E.	Becquerel traité du magnetisme.
1838,		5 05	"	Silliman's Journal, xxxiv, 1840.
1839,		3 31	"	" " " " "

See also C. S. report, 1856, p. 220, and C. S. report, 1858, p. 192.

Mobile, Ala.

See C. S. report, 1855, p. 323, also C. S. report, 1858, p. 192.

Havana, Cuba.

See C. S. report, 1855, p. 324.

1857, Jan.,	$D=$ 5° 15′ E.	Karl Friesach, Imp. Acad. of Sciences, Vienna, vol. xxix, 1858.

Jamaica, W. Indies.

1732,	$D=$ 6° to 6° 05′ E.	J. Harris at Black river, in March and April. Phil. Trans., 1733.
1789–93,	6 50 "	J. Leard, map of Port Royal.
1791–92,	6 45 "	" " "
1819,	4 50 "	DeMackau, Becquerel's traité du magnetisme, Paris, 1846.
1821,	4 50 "	DeMayne, " "
1822,	4 54 "	Owen, " "
1832,	5 13 "	Foster, " "
1833?	4 40 "	From a map.
1840?	4 00 "	Gen. Sabine's isogonic map of the Atlantic Ocean.
1857, March,	3 40 "	Karl Friesach, Imp. Acad. of Sciences, Vienna, vol. xxix, 1858.

Panama, New Granada.

1775, Nov.,	$D=$ 7° 49′ E.	Encycl. Brit.
1791, Dec.,	7 49 "	" "
1802,	8 00 "	" "
1822,	7 00 "	Hall, Becquerel's traité du magnetisme.
1837,	7 02 "	Sir E. Belcher.
1849,	6 55 "	Major Emory (Mexican Bound. Survey).

See also C. S. report, 1856, p. 223.

Vera Cruz, Mexico.

1726–27,	$D=$ 2° 15′ E.	J. Harris, Phil. Trans. R. S. anno 1728.
1769,	6 40 "	Encyc. Brit., 7th edition, 1842.
1769, March,	6 28 "	"
1776,	7 30 "	Don Ulloa, Encyc. Brit.
1815,	10 37 "	Malony.
1819, April,	9 16 "	Wise.

See also C. S. report, 1856, p. 214.

San Diego, Monterey, San Francisco and Cape Mendocino, California, and for Cape Disappointment, Washington Territory, see C. S. report, 1856, pp. 228 to 235.

Sitka, Russian America.

1804,	$D=$26° 45′ E.	Lissiansky, } Becquerel's traité du mag-
1824,	27 30 "	Kotzebue, } netisme.
1829,	28 19 "	Erman, }
1858,	30 00 "	From Evans' map of isogonic lines for 1858.

Washington, D. C.

Art. XXX.—*Caricography;* by Prof. C. Dewey.

(Continued from vol. xxviii, p. 232, Second Series.)

No. 260. *Carex argyrantha*, Tuckerman.

Spica composita; spiculis 4–8, ovato-rotundis vel obovatis sub-approximatis alternis albis, inferiore subremota, supernè staminiferis, squamosi-bracteatis, distigmaticis; fructibus ovatis compressis erectis vel sub-patulis nervosis margine membranaceo-alatis viridibus acuminato-rostratis brevi-bifidis, squamam membranaceam albam lanceolatam aequantibus.

Culm 1½–3 feet high, smooth, lax, reclining, and twice longer than the leaves; spikelets nearer above and white; fruit margined or winged widely for its length and width; light green.

Rocky Woods, Amherst and Sunderland, Mass.; *Prof. Tuckerman*, by whom the plant and his description have been kindly presented. It is related to *C. Deweyana*, and the white-glumed family, silver-flowered, according to its name, but appears to be new and distinct; discovered the last season.

Note. *C. Rugeliana*, Kunze, suppl. to Schkuhr, No. 56, p. 189, is *C. aestivalis*, Curtis, according to Boott, Illust., p. 54, No. 133. *C. miser*, Buckley, in this Journal, vol. xlv, p. 173, and vol. xlviii, p. 140, is considered by Dr. Boott to be *C. juncea*, Willd. System. Veg., 1826, No. 226. See Boott, Lin. Trans. vol. xx, p. 116, and Illust., p. 55. The descriptions of Willd. & Kunze sustain this conclusion of Dr. Boott.

261. *C. paludosa*, Goodenough. Schk. fig. 103.

Spicis pistilliferis, 2–4, sæpe 3, cylindraceis erectis oblongis, arctè-floriferis sub-approximatis, superioribus sessilibus, inferiore sæpe longo-pedunculata vix vaginata inferne attenuata et hinc sublaxiflora, alternatis et foliaceo-bracteatis; perigyniis (fructibus) ovatis in breve rostrum bidentatum attenuatis vel ovalibus acuminatis brevi-rostratis distinctè et multi-nervosis subcompressis subglabris tristigmaticis, squamam angustam lanceolatam aequantibus vel lanceolata cuspidata brevioribus.

Culm 1½–2 feet high, erect, triquetrous, scabrous above, longer than the rough-edged leaves, with leafy bracts equal to or surpassing the culm. Varies, like the European plant, in the length and thickness of its spikes, and in its glumes or scales.

Near Boston—*Wm. Boott, Esq.*, in 1859, probably introduced not many years since. Common in England, Germany, and Sweden.

262. *C. monile*, Tuckerman. Boott, Illust., No. 71.

Spicis staminiferis, 2–4, longis, cylindraceis, gracilibus cum squama longo-lanceolata; pistilliferis 2, rarò 1, oblongo-cylindraceis, subremotis, brevi-pedunculatis, sub-densifloris, infima interdum basin attenuata subnutante, foliaceo-bracteatis vix vaginatis; fructibus globosis vel ellipsoideis inflatis brevi-rostratis bidentatis glabris multi-nervatis stramineis cum ore rostri sub-obliquo, squama angusta oblonga lanceolata sub-duplo longioribus.

Culm 15-30 inches high, erect, triquetrous, longer than the leaves; bracts surpassing the culm, bright yellowish green.

In marshes, not abundant, N. England—*Tuckerman;* Rhode Island—*Olney;* New Jersey, Ohio and westward.

Note 1. The Carex, No. 197, vol. xlix, p. 47 of this Journal, accidentally misnamed, is *C. Vaseyi*, Dew., of which No. 197 contains the accurate description. From the preceding, *C. monile*, Tuck., the fruit is very different, being ovate, long-conic, subtriquetrous-inflated, glabrous and scabro-rostrate. *C. Vaseyi* is the plant referred to by Dr. Boott, Illust., No. 71, as different from *C. vesicaria* and *C. monile*, but not named by him among those sent him from Penn Yan, N. Y., by Dr. Sartwell. The reference of No. 197 above to No. 71 in the Illust. is, of course, an oversight. The correction on 197 is *C. Vaseyi*, Dew.

Note 2. *C. bullata*, Schk., Fig. 166, described in this Journal, vol. ix p. 71, 1825, from living specimens, and named from its (ball-shaped) nearly globose fruit, seems to me, as it does to Carey in Gray's Manual, distinct from *C. cylindrica*, Schw., and from the following number.

263. *C. physema*, Dew. *C. bullata*, Boott, Illust., No. 71, and Carey (non Schk).

Spicis staminiferis, 2–3, cylindraceis, gracilibus, contiguis, infima bracteata; pistillifera 1, interdum 2, subrotunda vel oblongo-cylindracea perdensiflora et crassa remota et subfulva, infima pedunculata et subnutante vel erecta longi-foliacea bracteata; fructibus turgidi-ovatis longi-cylindraceis rostratis bifurcatisque, inflatis glabris et scabro-dentatis vel serratis, squama lanceolata acuta albi-marginata longioribus et latioribus.

Culm 1–2 foot high or more, firm, slender for the thickness of pistillate spike, stiff, triquetrous and often roughish, shorter than the narrow, flat and prim leaves; bright green.

Humid meadows, New England to Pennsylvania.

On *C. bullata*, Schk., Fig. 166, the pistillate spikes are shown as long and loose-flowered, and the fruit globose (ovate-globose), inflated abruptly, contracted into a slender, round, long, scabrous bifurcate beak, with a glume about half as long.

On the Carex, Boott, Illust., No. 39, the fruit is very large and inflated-ovate, with a conic, tapering, three-sided beak, scabrous-dentate, forming thick, dense and large spikes. If the figure by Dr. Boott shows *C. bullata*, Schk., then the figure in Schk. is a palpable caricature. Trusting to the correctness of the figure of Schk., I may yet say that Dr. Boott has presented a well known and distinct form. It is obvious that it should have another name, which designates the *inflation* of the fruit or perigynium, like the other.

264. *C. Olneyi*, Boott, Illust., No. 40.

Spicis staminiferis, 2–4, saepe 3, cylindraceis approximatis gracilibus; pistilliferis saepe 2, vel 1–3, cylindaceis sub-crassis densifloris stramineis approximatis plus minus pedunculatis, infima basin tereti laxiflora saepe subnutante, bracteatis; fructibus inflati-ovatis brevi-conico-rostratis scabro-bifurcatis nervosis divergentibus, squama lanceolata acuta vel cuspidata longioribus.

Culm 15–22 inches high, strong, obtusely triquetrous, scabrous above, shorter than the long and stiff margined leaves.

Rhode Island—*Olney;* probably associated with this group over the country. Were it not for the very different spikes, the fruit would closely ally this species to *C. physema*, as being a smaller form of it.

Remark.—This Vesicaria group is of difficult determination, and there has been much confusion in consequence. Hoping that some light has shined upon it, I can only say with Dr. Boott, that "future observation must determine in America the value to be affixed to the species of this group." The following shows the group as here exhibited:

C. monile, Tuckerman. Boott, Illust., No. 39.
C. Vaseyi, Dew. *C. monile*, Sart., Exsic. No. 151, and Sill. Journ., [1] vol. 48, p. 47, putting *C. Vaseyi* for *C. monile*.
C. bullata, Schk. Dew., Sill. Journ. vol. 9, p. 71 (not Boott or Carey).
C. physema, Dew. *C. bullata*, Boott, and Carey in Manual.
C. Tuckermani, Boott. Dew., Sill. Journ., vol. 49, p. 47. *C. cylindrica*, Carey.
C. Olneyi, Boott, Illust., and as above.

As Dr. Boott has found *C. lenticularis*, Mx., among the northern Carices, it is now distinguished and identified. The great difficulty had been in the imperfection of the description of Michaux. This is removed by Dr. Boott, which the younger botanists will be glad to see, and also the more complete description.

C. lenticularis, Mx. Boott, Illust., No. 76, Fig. 77. *C. concolor*, R. Br. in this Journal.

Spicis cylindraceis obtusis approximatis et sessilibus; staminifera unica, interdum 2, infima brevi, vel terminali superne sæpe fructifera; pistilliferis 2–5, vel rarò pluribus, foliato-bracteatis, interdum inferne staminiferis, infima vix sessili; fructibus ellipticis convexo-lenticularibus, interdum sub-ovatis, per-brevi-rostellatis nervosis stramineis glabris, squama oblonga *obtusa* pallida longioribus; planta matura concolore.

Culm 8–14 inches high, triquetrous, erect, leafy towards the base, leaves about the length of the culm, and sheaths longer than the culm; terminal spike staminate, often only staminate below, sometimes a shorter staminate sessile spike near it; pistillate spikes 3–4, or more or less, cylindrical, erect, the lowest sometimes vaginate-bracted; stigmas 2; fruit sub-ovate, longer than the oblong obtuse white-edged scale; whole plant light green, nearly of the same color.

Lake of Swans and Arctic America, *Michaux and Richardson.* Var. Albi-montana, has fruit less oval, or ovate and acutish, tapering above, resembling somewhat *C. torta*, but taller than the Arctic plants. White Mountains, N. H., about ponds—*Tuckerman.* In Harrison, Me., about ponds, in 1859—*Rev. J. Blake.*

Errata.—On p. 232, vol. xxviii, for *C. gynocratis* read *C. gynocrates.* On p. 231, same vol., for vol. xxiv, p. 48, read vol. xxvii, p. 81, Sec. Ser., and for the numbers 254, 255 and 256, read 257, 258 and 259.

ART. XXXI.—*On Numerical Relations existing between the Equivalent Numbers of Elementary Bodies;* by M. CAREY LEA, Philadelphia. Part II.

(Concluded from p. 111.)

On Geometrical Ratios existing between Equivalent Numbers.

THE First Part of this paper was devoted to the examination of relations between the equivalent numbers of certain elementary bodies depending upon the number 44–45, and it was attempted to show:—

1st. That such relations extend to nearly all the elements:—

2d. That the particular groups collected together by this relation consist of bodies whose properties are analogous, and that the classification is in harmony with the distinguishing characteristics of the substances classified.

The first portion of this Second Part will present a species of relation wholly distinct, it is believed, from any that has hitherto been pointed out, and which may be not inappropriately termed Geometrical Ratios, to distinguish them from the more familiar arithmetical relations which have been heretofore exclusively studied by chemists.

The arithmetical relations are susceptible of at least an hypothetical explanation, on the supposition that the common difference in a series of elements may represent the equivalent number of a substance as yet undetermined, which, by its combinations in varying proportions, gives rise to the bodies constituting the successive terms of the series. The analogies which are now to be considered are more difficult of explanation, even by hypothesis. Their accuracy, sometimes absolute, renders improbable the supposition that they are mere casual coincidences. In science it is not permitted to neglect facts merely because we cannot satisfactorily account for them.

The nature of these relations consists in this, that if we take two substances and examine the ratio which subsists between the numbers representing their atomic weights, we may find in certain cases, that it is identical with the ratio subsisting between the atomic weights of two other substances, and so on through a considerable number of elements. The ratio between the atomic weights, for instance, of oxygen and nitrogen, is that of four to seven, so likewise is that between those of zirconium and potassium, potassium and barium, with absolute exactitude. What renders this the more remarkable is, that all three of these last substances are striking exceptions to Prout's law that the equivalents of the elements are exact multiples of that of hydrogen: they all have decimals, zirconium 22·4, potassium 39·2, barium 68·6. Now the ratio just mentioned gives these num-

bers with their decimals with perfect exactness. The same species of relation exists between many other elements, as will be seen by the table below :—

(1.)

Oxygen-Nitrogen Ratio, or that of Four to Seven.

			Atomic wts. calculated.		Atomic wts. received.
Nitrogen	= 14,	$\frac{4}{7}$ of 14	= 8	Oxygen	= 8
Barium	= 68·6,	$\frac{4}{7}$ " 68·6	= 39·2	Potassium	=39·2
Potassium	= 39·2,	$\frac{4}{7}$ " 39·2	= 22·4	Zirconium	=22·4
Calcium	= 20,	$\frac{4}{7}$ " 20	= 11·43	Magnesium	=12
Magnesium	= 12,	$\frac{4}{7}$ " 12	= 6·86	Glucinum	=7*
Strontium	= 43·75,	$\frac{4}{7}$ " 43·75	= 25	Titanium	=25
Lead	= 103·5,	$\frac{4}{7}$ " 103·5	= 59·16	Tin	=59
Antimony	= 120·3,	$\frac{4}{7}$ " 120·3	= 68·76	Vanadium	=68·60
Bismuth	= 208,	$\frac{4}{7}$ " 208	= 118·84	Antimony	=120·3
Mercury	= 100,	$\frac{4}{7}$ " 100	= 57·16	Cadmium	=56
		$\frac{4}{7}$ " 57·16	= 32·66	Zinc	=32·60
Molybdenum	= 48,	$\frac{4}{7}$ " 48	= 27·42	Chromium	=26·70
Chlorine	= 35·5,	$\frac{4}{7}$ " 35·5	= 20·28	Silicon	=21
Fluorine	= 19,	$\frac{4}{7}$ " 19	= 10·86	Boron	=10·9†
Boron	= 10·9,	$\frac{4}{7}$ " 10·9	= 6·23	Carbon	=6

It will be remarked that mercury, cadmium and zinc are here again brought together. Although four-sevenths of the atomic weight of mercury is not that of cadmium exactly, nevertheless four-sevenths the resulting number so obtained, viz. 57·16, gives for the atomic weight of zinc 32·66, an exceedingly close approximation.

The last three equations in the table show us that the atomic weight of silicon stands nearly in the same numerical ratio to that of boron, as that of chlorine does to that of fluorine, and that both these ratios, especially the latter, approach nearly to that existing between the atomic weight of boron and carbon.

Now as the atomic weight of boron is by no means positively determined, it may be allowable to examine how far an hypothetical number will fulfill these several ratios. Let us assume:—

Fluorine : Chlorine : : Carbon : Boron

we find:—

$$\frac{\text{Chlorine } 35{\cdot}5 \times \text{Carbon } 6}{\text{Fluorine } 19} = 11{\cdot}2104,$$

and obtain for the hypothetical equivalent of boron the number 11·21 (neglecting the last decimal figures).

Let us now examine how far the number 11·21 will fulfill the second proposed ratio, viz.

Carbon : Boron : : Boron : Silicon

* Taking Glucina as G_2O_3.

† See Jahresbericht, 1858.

we have $\frac{(\text{Boron } 11{\cdot}21)^2}{\text{Carbon } 6} = 20{\cdot}944$:—

a close approximation to 21, the received number.

If, therefore, we assume the atomic weight of boron to be a mean proportional between those of carbon and silicon, which we may do by an alteration certainly within the bounds of possible error in determinations so far made, we find that the proportion between the weights of carbon and boron, of boron and silicon, is the same as that between those of fluorine and chlorine.

(2.)

Carbon-Nitrogen Ratio, or that of Three-Sevenths.

The atomic weight of Carbon stands to that of Nitrogen in the ratio of 3 to 7, a proportion which is found exactly or approximately to extend to certain other elements.

Nitrogen	= 14,	$\frac{3}{7}$ of 14	= 6	Carbon	= 6
Fluorine	= 19,	$\frac{3}{7}$ " 19	= 8·14	Oxygen	= 8
Iron	= 28,	$\frac{3}{7}$ " 28	= 12	Magnesium	= 12
Cerium	= 47,	$\frac{3}{7}$ " 47	= 20·14	Calcium	= 20
Phosphorus	= 31,	$\frac{3}{7}$ " 31	= 13·29	Nitrogen	= 14
Bromine	= 80,	$\frac{3}{7}$ " 80	= 34·29	Chlorine	= 35·5
Arsenic	= 75,	$\frac{3}{7}$ " 75	= 32·14	Zinc	= 32·6
Lead	= 103·5	$\frac{3}{7}$ " 103·5	= 44·4	Strontium	= 43·75
Cadmium	= 56,	$\frac{3}{7}$ " 56	= 24	2 Magnesium	= 24
Uranium	= 60,	$\frac{3}{7}$ " 60	= 25·71	Chromium	= 26·7

(3.)

The proportions expressed by the preceding tables may be differently presented, and perhaps rendered more striking. As the numbers which express the equivalent weights of the elements are altogether relative, it is of course a mere question of convenience which is selected as unity. If in place of adopting the equivalent of one substance, as that of hydrogen or oxygen, as a permanent unit, we successively make those of the substances contained in the right hand column of the table in section 1. our unit, and consider the effect of such a change upon the equivalents of the substances contained in the left-hand column, we shall obtain the following results:

Making the							
equivalent of	Oxygen	100,	the eq. of	Nitrogen	becomes	175
"	Potassium	100,	" " "	Barium	"	175
"	Zirconium	100,	" " "	Potassium	"	175
"	Titanium	100,	" " "	Strontium	"	175
"	Tin	100,	" " "	Lead	"	175·4
"	Vanadium	100,	" " "	Antimony	"	174·9
"	Boron	100,	" " "	Fluorine	"	174·3
	&c.			&c.		

The same view may be extended to Section 2. Assuming the atomic weight of the substances in the left-hand column successively as unity, or one hundred, we obtain the following results:

Making the equivalent of						
	Nitrogen	100	that of	Carbon	becomes	42·8
	Fluorine	100	" "	Oxygen	"	42·1
	Iron	100	" "	Magnesium	"	42·8
	Cerium	100	" "	Calcium	"	42·6
	&c.			&c.		

It is therefore clear that the atomic weight of each substance in the left hand column of these several tables bears to that of the corresponding substance in the right-hand column a definite numerical ratio, which is identical, or nearly so with that borne by the atomic weight of any other substance in the same column of the same table to that of the corresponding substance in the other column.

(4.)

We have seen that many elements stand to other elements in the same relation as nitrogen to oxygen—many in the same relation as nitrogen to carbon. Apart from these more general ratios, many elements may be classed together in double or treble pairs, such that the two elements in one pair stand to each other in the same numerical ratio as the two elements of a second or third pair, the two elements constituting each pair being more or less closely allied to each other in properties, though the pairs are not necessarily analogous with those with which they are compared.

For example, arsenic stands to antimony in the same numerical ratio as selenium to tellurium, within an extremely small fraction, so that by multiplying and dividing we have:—

$$\text{Arsenic } 75 \times \frac{\text{Tellurium } 64}{\text{Selenium } 40} = 120, \text{ Antimony} = 120{\cdot}3,$$

So in like manner magnesium stands to zirconium in the same ratio as fluorine to chlorine:—

$$\text{Magnesium } 12 \times \frac{\text{Chlorine } 35{\cdot}5}{\text{Fluorine } 19} = 22{\cdot}42, \text{ Zirconium} = 22{\cdot}40,$$

So carbon stands to boron in the same ratio as silver to gold:—

$$\text{Carbon } 6 \times \frac{\text{Gold } 197}{\text{Silver } 108} = 10{\cdot}94, \text{ Boron} = 10{\cdot}90.$$

These ratios, as well as those that follow, are very close approximations, certainly within the limits of error which may easily exist in the determinations on which we depend. For antimony we find 120, the recent determinations vary from 119 to 122, that which appears most reliable is 120·3, as adopted by the Jahres-

bericht. In the second case, the number found for zirconium varies but $\frac{1}{111}$ from that generally received. In the third, the number found for boron is intermediate between the number adopted in the Jahresbericht 10·90 and that found by Deville, 11. Discrepancies such as these are trifling in the extreme, and have not the slightest real significance.

Phosphorus stands to nitrogen in nearly the same ratio as strontium to calcium:—

$$\text{Phosphorus } 31 \times \frac{\text{Calcium } 20}{\text{Strontium } 43{\cdot}77} = 14{\cdot}16, \text{ Nitrogen} = 14.$$

Tin stands to titanium in nearly the same ratio as iron to magnesium:—

$$\text{Tin } 59 \times \frac{\text{Magnesium } 12}{\text{Iron } 28} = 25{\cdot}28, \text{ Titanium} = 25.$$

Tin stands to zinc in almost exactly the same ratio as gold to silver, or as boron to carbon:—

$$\text{Tin } 59 \times \frac{\text{Silver } 108}{\text{Gold } 197} = 32{\cdot}35, \text{ Zinc} = 32{\cdot}60.$$

$$\text{Tin } 59 \times \frac{\text{Carbon } 6}{\text{Boron } 10{\cdot}9} = 32{\cdot}48, \text{ Zinc} = 32{\cdot}60.$$

These and many other analogies of the same character are brought together in the following table, by which the ratios of comparison between each pair are shown, up to the second place of decimals, beyond which it is pseudo-accuracy to go, in view of the data.

Ratio of tellurium to selenium, or	$\frac{\text{Te } 64}{\text{Se } 40} = 1{\cdot}60$
Ratio of antimony to arsenic, or	$\frac{\text{Sb } 120}{\text{As } 75} = 1{\cdot}60$
Ratio of zirconium to magnesium,	$\frac{\text{Zr } 22{\cdot}4}{\text{Mg } 12} = 1{\cdot}87$
Ratio of chlorine to fluorine,	$\frac{\text{Cl } 35{\cdot}5}{\text{F } 19} = 1{\cdot}87$
Ratio of boron to carbon,	$\frac{\text{B } 10{\cdot}9}{\text{C } 6} = 1{\cdot}82$
Ratio of gold to silver.	$\frac{\text{Au } 197}{\text{Ag } 108} = 1{\cdot}82$
Ratio of strontium to calcium,	$\frac{\text{Sr } 43{\cdot}77}{\text{Ca } 20} = 2{\cdot}19$
Ratio of phosphorus to nitrogen,	$\frac{\text{P } 31}{\text{N } 14} = 2{\cdot}21$

Ratio of iron to magnesium,	$\frac{\text{Fe } 28}{\text{Mg } 12} = 2{\cdot}33$
Ratio of tin to titanium,	$\frac{\text{Sn } 59}{\text{Ti } 25} = 2{\cdot}36$
Ratio of tin to zinc,	$\frac{\text{Sn } 59}{\text{Zn } 32{\cdot}6} = 1{\cdot}81$
Ratio of gold to silver,	$\frac{\text{Au } 197}{\text{Ag } 108} = 1{\cdot}82$
Ratio of zirconium to aluminum,	$\frac{\text{Zr } 22{\cdot}4}{\text{Al } 13{\cdot}7} = 1{\cdot}64$
Ratio of calcium to magnesium,	$\frac{\text{Ca } 20}{\text{Mg } 12} = 1{\cdot}67$
Ratio of potassium to sodium,	$\frac{\text{K } 39{\cdot}2}{\text{Na } 23} = 1{\cdot}70$
Ratio of arsenic to phosphorus,	$\frac{\text{As } 75}{\text{P } 31} = 2{\cdot}42$
Ratio of cobalt to magnesium,	$\frac{\text{Co } 29{\cdot}5}{\text{Mg } 12} = 2{\cdot}46$
Ratio of nickel to magnesium,	$\frac{\text{Ni } 29{\cdot}6}{\text{Mg } 12} = 2{\cdot}47$
Ratio of lead to tin,	$\frac{\text{Pb } 103{\cdot}5}{\text{Sn } 59} = 1{\cdot}75$
Ratio of cadmium to zinc,	$\frac{\text{Cd } 56}{\text{Zn } 32{\cdot}6} = 1{\cdot}72$

(5.)

It has been the object of this paper to develope as far as possible those numerical relations existing between the atomic weights of the elements which have not been previously observed. It is, perhaps, impracticable in the present state of chemical science to explain why such relations should exist, nevertheless, nothing which tends to an exacter knowledge of the laws which govern the proportions in which the elements combine should be neglected. In this way, little by little, the materials are collected for future generalizations, with the reasonable hope of eventually arriving at an intimate knowledge of the true constitution of the materials which compose our globe.

The substances which compose the chlorine group form a well marked family to which fluorine seems also to belong. The analogies which unite chlorine, bromine and iodine, appear to multiply with each new investigation of their properties. By none have they been more strikingly illustrated than by the recent experiments of Plücker on the spectra obtained from the light of electric discharges through gases in a state of extreme

rarefaction, demonstrating that those given by Cl, Br and I, resembled each other in exhibiting great numbers of black lines of extreme fineness, so fine indeed as to be almost mathematical lines, and that in this respect these elements differed wholly from all others. With so remarkable an experiment as this before us, supported by the very numerous other relations which exist between these substances, we might naturally look to find striking numerical correspondences between their atomic weights, but the analyses upon which we at present depend give us numbers which afford no relations positively exact. Of the four numbers 19, 35·5, 80 and 127, two are prime, one fractional, and one has many divisors. Such numbers are very unpromising for the development of numerical relation.

Thus far, however, at least relations do exist: that it is possible to express the value of the equivalent of any one of these substances in terms of any two of the remaining—each equivalent is a function of any other two, thus:—

$$I = 10\,Cl - 12\,F \qquad Cl = \frac{12\,Br - 7\,I}{2}$$

$$I = \frac{5\,Br - F}{3} \qquad Cl = \frac{I + 12\,F}{10}$$

$$I = \frac{12\,Br - 2\,Cl}{7} \qquad Cl = \frac{Br - 7\,F}{6}$$

$$\overline{Br = 6\,Cl - 7\,F} \qquad \overline{F = \frac{10\,Cl - I}{12}}$$

$$Br = \frac{2\,Cl + 7\,I}{12} \qquad F = \frac{6\,Cl - Br}{7}$$

$$Br = \frac{3\,I + F}{5} \qquad F = 5\,Br - 3\,I$$

If these equations represented approximations, no matter how close, they would not be worthy of consideration. They are perfectly exact. The quasi-connection of oxygen with this series will be pointed out further on.

(6.)

It has been remarked that the atomic weights of the members of the oxygen series proper differ from each other by whole multiples of the atomic weight of oxygen, but the extent to which differences of this kind exist amongst the atomic weights of the elementary bodies has perhaps not been pointed out.

The elements having the highest atomic weights are bismuth and gold, commencing with the first of these substances, and diminishing its atomic weight successively by whole multiples (in one case by a sub-multiple) we obtain the following results:—

Differences.		
	208, Bismuth	= 208
8×10	128	
	..... Iodine	= 127
8		
	120, Antimony	= 120·3
8×2		
	104	
	..... Lead	= 103·5
8		
	96, Osmium	= 97–99
8×2		
	80	
	..... Bromine	= 80
8×½		
	76, Arsenic	= 75
8		
	68, Vanadium	= 68·6
	..... Barium	= 68·6
8		
	60, Uranium	= 60
8		
	52, Ruthenium	= 52·2
8		
	44	
	..... Strontium	= 43·77
8		
	36	
	..... Chlorine	= 35·5
8×2		
	20	
	..... Fluorine	= 19
	Calcium	= 20
8		
	12	
	..... Magnesium	= 12

It has not been usual to classify vanadium, osmium or ruthenium with the arsenic series, but Schafarik in a paper on the vanadium compounds,* and Hallwachs and Schafarik in a subsequent paper† on allied subjects (to neither of which the author had access while engaged on the first part of this paper except in the form of a brief notice) are of opinion that vanadium should be removed from the molybdenum group in which it has heretofore been classed, and be transferred to the arsenic series, an opinion which they support by arguments founded on the fact that the specific volume as well of vanadic acid as of the

* Sitzungsbericht of the Acad. of Sciences of Vienna, Bd. xxxiii, ext. in Chemisches Centralblatt, 1859, 97.

† Same vol. of Sitzungsbericht, ext. in Chemisches Centralblatt, 1859, p. 161.

metal itself, corresponds with those of the metals of the arsenic series, viz.:

		Specif. Vol.	
Vanadic acid,	VO_3	26·5	
Arsenious acid,	AsO_3	26·6	
Antimonic oxyd,	SbO_3	25·9	
Bismuthic oxyd,	BiO_3	25·9*	28·4†

They also point out the fact that vanadinite (vanadinbleierz) is isomorphous with the analogous compounds of the arsenic series, mimetene (kampylit) and pyromorphite. Professor Mallet has shown that reasons can be given for classifying osmium also in the arsenic series.‡

Again, commencing with gold we obtain the following succession of numbers.

Differences.			
8×11	196 Gold	=197	
	108 Silver	=108	
8	100 Mercury	=100	
8	92 Tungsten	= 92	
8×3½	64 Tellurium	= 64	
8	56	Cadmium	=56
8	48 Molybdenum	= 48	
8	40 Selenium	= 40	
8	32	Zinc	=32·6
8×2	16 Sulphur	= 16	
8	8 Oxygen	= 8§	

In an interesting paper published in the Memoirs of the Am. Acad. of Boston, vol. v, Prof. J. P. Cooke, of Harvard University, attempted a classification of all the elementary bodies by making them all functions of a general series of the form $a+dx$. By giving fixed values to a and d particular expressions were obtained, giving rise to series by the changes in the value of the variable x. These particular series were characterized by the value of d, which in different series became successively 3, 4, 5,

* Boullay. † Karsten. ‡ Am. Jour. Science, xxix, 49.

§ If to the at. wt. of Li which may be taken at 7, we add 16=2×8, we have 23 the exact at. wt. of Na, and a further addition of 16 gives very nearly the at. wt. of K.

6, 8 and 9. The values of a were likewise always small, never exceeding 8. The values of x were restricted to whole numbers.

This view, although new and ingenious, is evidently exposed to a serious objection: the series include too much. The form entitled by Prof. Cooke the "Three Series," and expressed by $1+3x$, includes one-third of all possible whole numbers, and so to a proportionally great extent with all the other forms. As the author did not make positive exactness essential, it is evident that a wide scope was given for the classification of elements under any particular series: therefore this theory could only find favor as far as it might be made to conform to a wholly unobjectionable classification of the elements. In this it only partially succeeded, as will appear from an examination of the substances included in the various groups.

In the first series, chromium, manganese, osmium and gold are classed as affiliated to the chlorine group, into which however the series only admits fluorine with an error of 2, or 12 per cent.

In the second, arsenic and manganese are made affiliated with the sulphur group, which includes also molybdenum, vanadium, &c.

In the third, oxygen is classed with the nitrogen-phosphorus group, into which antimony only enters with an error of 7·7.*

In the fifth we find tin and titanium, the platinum group, gold, mercury, and most of the magnesia group.

In the sixth we have part of the remainder of the magnesia group, the metals of the alkaline earths and lead, the alkaline metals, hydrogen and silver, with copper and manganese as affiliations. Rendering all justice to the author for the originality and ingenuity of his views, it must be admitted that the flexibility of his series has led to a classification not in all respects supported by analogies. Five out of his six series contain one or more members of the magnesia group either directly or as affiliated members.

Dumas has followed out these ideas of Prof. Cooke and extended them. In place of referring his series to the type of the formic acid series alone, he includes the types of substituted ammoniums and stannethyls, under the general form $na+xd+yd'$; thus adopting an expression even more general than that of Prof. Cooke, but restricting it more closely in its application.

Perhaps the most beautiful and important of the relations pointed out by Dumas, are the parallel series of numbers, which by the subtraction of each term of the one from the corresponding term of the other, exhibit a constant difference within a certain degree of approximation.

* This probably arises from the fact that the equivalent of antimony as generally received at the time when Prof. Cooke wrote was higher than it is now known to be, and by diminishing the value of the variable x corresponding to this term, by 1, a nearer approximation would be obtained.

The analogies pointed out in the several parts of this paper evidently lead directly to the construction of series of the same kind some of which, together with others depending upon yet different relations are given below.

−Oxygen	=−8	Chlorine	=35·5	Bromine	=80	Iodine	=127
−Zinc	=−32·6	Magnesia	=12	Cadmium	=56	Lead	=103·5
	24·6		23·5		24		23·5

In connection with these two parallel series we may remark that oxygen appears to constitute a negative term in the chlorine series, precisely as nitrogen does in the phosphorus and zinc in the cadmium series, with considerable approximation to exactness. If the atomic weight of chlorine were taken at 36 instead of 35·5 it would constitute an exact numerical mean between the atomic weights of bromine and oxygen supposing the latter to be taken with a negative sign. We have before seen that nitrogen, the negative member of the phosphorus series, is less closely allied with the rest than they are with each other. Still greater is the step between chlorine and oxygen, so great indeed that it is very doubtful whether they can properly be classed in the same series, although certain cases of isomorphism can be urged in favor of such a classification.

We here see a new instance of the existence of the relation of 44—45 developed in the first part of this paper.

Differences.	Calculated equivalents.		Received equivalents.	
	− 8	Oxygen	= 8	
44	36	Chlorine	= 35·5	
44	80	Bromine	= 80	
44	124	Iodine	=127	

Gold	=197	M	=152·5	Silver	=108	Mercury	=100
Mercury	=100	Cadmium	= 56	Magnesium	= 12	Glucinum	= 4·7
	97		96·5		96		95·3

M here represents a possible metal as yet unknown. In the first part of this paper mention was made of the possibility of the existence of such a metal, having an atomic weight representing the arithmetical mean between those of gold and silver.

Bismuth	=208	M′	=164	Antimony	=120·3	Lead	=103·5
Antimony	=120·3	Arsenic	= 75	Phosphorus	= 31	Nitrogen	= 14
	87·7		89		89·3		89·5

In this double series we find nearly the same number (89 approximatively) obtained by subtraction, as by addition in the last of the double series, part first, section 8. If in that just presented we replace lead by arsenic and give a negative sign to

the atomic weight of nitrogen, we shall still have a number conforming to the character of the series, viz., 89.

In this and the following series the symbol M′ represents a possible metal constituting an intermediate term between antimony and bismuth. That such a metal might exist was pointed out in the consideration of the phosphorus series.

Bismuth =208	M′ =164	Antimony =120·3	Arsenic =75
Gold =197	M =152·5	Silver =108	Copper =63·4
11	11·5	12·3	11·6

M as before represents an hypothetical metal having for its atomic weight a mean term between those of silver and gold.

Uranium 60	Vanadium 68·6	Tungsten 92
Magnesim 12	Calcium 20	Strontium 43·75
48	48·6	48·25

Molybdenum 48	Vanadium 68·6	Tungsten 92	2 Tantalum 137·6
Magnesium 12	Zinc 32·6	Cadmium 56	Mercury 100
36	36	36	37·6

The parallelism between the three first terms of these last two series commencing respectively with molybdenum and magnesium is positively exact, perhaps the only known case in which absolute exactitude obtains. It is probable that other cases of parallel series exist, and will be discovered.

It is not easy to fix the exact amount of importance which attaches to the numerical relations up to this time ascertained to exist between the atomic weights of the elements. Some are no doubt mere casual coincidences, and relations remarkably exact and symmetrical may exist between the atomic weights of bodies which have no analogies in their properties: for example we may take calcium 20, selenium 40, uranium 60, bromine 80, mercury 100. Here the differences are not only exact, but all the subsequent numbers are multiples of the first, and this between bodies remarkably dissimilar in their properties—a striking proof of the necessity of caution in inferring relations of properties as following from relations of numbers. But on the other hand, to reject the relations of number when accompanied by analogy of properties, as unmeaning and unimportant, would be to err quite as much on the other side. When the received equivalent of an element forming a term in a well marked series differs from that obtained by calculation, it naturally leads, as Prof. Mallet has remarked, to suspect an error and desire a redetermination. The fact that a group of elements allied in their chemical characters may be arranged in a series having a common difference or a definite ratio between its terms, confirms the propriety of grouping those elements together, and such analogies may in doubtful cases assist us in arriving at a correct classification.

Philadelphia, Feb. 27, 1860.

ART. XXXII.—*Ornithichnites, or tracks resembling those of Birds;* by ROSWELL FIELD, of Greenfield, Mass.

WHEN fossil footprints were first discovered in the sandstones of the Connecticut Valley, it was indeed thought to be a great discovery, but that the tracks, thus found were made by birds was received by men of scientific attainments with great distrust and skepticism. That they were tracks made by once living animals there could be no doubt, but that they were ornithichnites was very much doubted.

It was not indeed until after my esteemed friend Dr. Hitchcock had spent much time in comparing, describing, and in distributing specimens, that the scientific public became satisfied that they were the tracks of once living birds.

The great and only proof that they were the tracks of birds, is found in the organization of the fossil foot, in the numbers of joints or lateral expansions in the toes; in this they are supposed to agree, and probably do, with living types; this with alternate steps of right and left feet is all the evidence we have that they were the tracks of birds.

Living in the immediate vicinity of Turner's Falls, the locality that has furnished the most numerous, and beyond all comparison the most beautiful specimens, my attention was drawn many years since to this particular subject. It was from my farm that the late Dexter Marsh obtained his choicest specimens. And it was in the vicinity of these Falls where my much lamented friend Dr. Deane found "new walks in an old field:" Where our barren and rocky wastes became to him a garden of delight.

It was here I witnessed their labors with pleasure, and in a more obscure way have followed in their footsteps. I think I may safely say that I have uncovered more footprints, and found more new species, and a greater variety of tracks than any other man, I think I might also say with propriety than all others that have preceded me, and if I have learnt anything on this subject I have learnt it at the quarries. It is there, and there only I have studied the history of Triassic days, and the more I have studied, the greater have been my doubts as to the ornithic character of any of the tracks which these tables of stone contain. I have seen thousands of tracks that others have not seen. With injudicious blasting, and the carelessness of workmen many choice specimens have been broken and lost; other slabs literally covered with footprints, have been spoilt by suncracks the shrinkage of the mud in drying; the stratum over which the animal moved being either too hard or too soft to receive or retain good impressions, all such are rejected and lost to the student, at the quarries.

I have no new theory to advance, and none to build up, but if I can rightly decipher these fossil inscriptions impressed on the tombstones of a race of animals that have long since ceased to exist, they should all of them be classed in the animal kingdom as Reptilia. If I have not studied this subject in vain they were all quadrupedal. That they usually walked on two feet I admit, and that they could as readily walk on four when necessary is equally true. In proof of this we find tracks as perfect as if made in plaster or wax, which to all appearance as to the number of toes, and the phalangeal or lateral expansions in the toes agree perfectly with those of living birds, and still we know by the impressions made by their forward feet that these fossil tracks were made by quadrupeds. In other cases where the animals sunk deep in the muddy stratum over which they moved, it is plain that they dragged their tails in the mud, leaving a groove plowed up from one half inch to an inch in width. This groove is not always found on the surface where the foot rested, the weight of the animal causing the foot to sink through the yielding stratum, whilst the tail dragged on the one above. This we know was the case with animals that were surely quadrupeds, but they show the appendage of a tail only when their feet sunk deeply in the plastic clay. Thus the proof that we once relied upon to prove them birds can be relied upon no longer.

That there were quadrupeds in those sandstone days and that these had hind feet perfectly agreeing with the stony bird-tracks, throws great doubt and distrust on the question, whether there were any true birds in this age of reptiles.

If there were birds they were doubtless apterous and naked, for we should naturally suppose that where so large a number of birds congregated upon the muddy banks, that in dressing and pluming their feathers some of them must have been trodden under foot, but the impression of feathers has never been found, although we find the smallest leaves of vegetables, and the pathway and tracks of annelids, and insects, some of them so small that they can hardly be seen with the naked eye. Even the Otozoum whose giant-like track measures twenty inches in length, once supposed to have been a biped reptile, by later discoveries is proved to have been four-footed. Other new discoveries have reduced the number of so-called birds, transferring them to the class of quadrupeds, which I verily believe is the proper place for all of them. The smoothness of the bottom of the foot in our fossil tracks agrees better with some species of batrachians that now live in and about the water, than it does with such animals as live on the land. Had birds existed at this early geological period, when the sandstone of the Connecticut valley was being deposited, there has indeed been a woful gap in their history, from then up to near the historical period, while the die from

which they were struck at their creation was not broken, but a new edition produced in these latter days. The work perhaps may have been revised but has not been enlarged as respects the size of the animal. I know that many eminent men and men of great scientific attainments, men who have spent much time and labor for many years in the investigation of this subject have come to different conclusions, and it may not become me to say that their conclusions are wrong. I would only add that when fossil tracks were first discovered there was so little known of the formation of the feet of fossil or of living animals, and particularly of their footprints that it is possible the first discoverers might have been mistaken as to the ornithic character of the footprints. The study of these fossils so very interesting to the geologist and naturalist, still merits their earnest attention. There is no known locality where they are found in such abundance, and in such perfection as at Turner's Falls, the northern terminus of the sandstone beds. Very few indeed have any conception of the marvelous perfection of this fossil inscription, or of the multitudes of once living creatures whose existence they commemorate.

March, 1860.

[Mr. Field is a plain farmer, who makes no claim to be an authority in science, but like Hugh Miller has hammered his geology out of the rocks on which he lives. He is well known as one of the most successful collectors of the foot-marks of the Connecticut sandstone, and his testimony as to the impression made on himself of their probable character and origin, has the merit of a conviction making head in an honest mind against all the weight and bias of opposing authorities.—Eds.]

Art. XXXIII.—*Eighth Supplement to Dana's Mineralogy;* by Geo. J. Brush, Professor of Metallurgy in Yale College.*

List of Works, etc.

F. X. M. Zippe: Lehrbuch der Mineralogie mit naturhistorischer Grundlage. pp. 450, 8vo, mit 334 Fig. Wien, 1860.

A. Descloizeaux: Sur l'emploi des propriétés optiques biréfringentes pour la détermination des espèces cristallisées. p. 88, 8vo. Extrait des Annales des Mines, tome xiv, 1858.

A. Delesse: Etudes sur le Métamorphisme. Roches granitiques, pp. 77, 8vo. Extrait des Annales des Mines, tome xii.

Carl F. Naumann: Elemente der Mineralogie, fünfte vermehrte und verbesserte Auflage. 8vo, pp. 460, mit 483 Fig. Leipzig, 1859.

N. von Kokscharow: Materialen zur Mineralogie Russlands, dritter Band, Lieferung 1—3, pp. 128, mit Atlas. St. Petersburg, 1859.—This continuation of Kokscharow's great work, contains monographs of the species garnet, magnetite, anal-

* In the absence of Professor Dana I have endeavored to give an abstract of the results of the mineralogical researches, published since the appearance of the seventh Supplement.—G. J. B.—New Haven, April 1, 1860.

cime and euclase, together with important additional notes upon beryl, cancrinite, nepheline, phenacite, and apatite.

ADAM: Extrait du Tableau Minéralogique. 8vo, pp. 14. Paris.

J. F. L. HAUSMANN: Ueber die Krystallformen des Cordierites von Bodenmais in Bayern. 4to. pp. 16. Göttingen, 1859.

GUSTAV ROSE: Ueber die heteromorphen Zustande der kohlensauren Kalkerde, zweite Abhandlung, mit drei Kupfertafeln. 4to. pp. 48. Berlin, 1859.

VICTOR VON LANG: Versuch einer Monographie des Bleivitriols. 8vo, pp. 54, mit xxvii Tafeln. Wien, 1859.

D. D. OWEN: *First Report of a Geological Reconnaissance of the Northern Counties of Arkansas.* Little Rock, 1858.—In this report Dr. Elderhorst has contributed much that is of interest in regard to the ores of zinc, lead and manganese, and presented his facts in a manner that will make them of permanent practical value.

H. KOPP und H. WILL: Jahresbericht über die Fortschritte der Chemie und verwandter Theile anderer Wissenschaften für 1858. Giessen, 1859. pp. 859.—Pages 673 to 812 contain Dr. Kopp's excellent review of the progress of mineralogical science for the year 1858.

H. C. SORBY: On the Microscopical Structure of Crystals, indicating the Origin of Minerals and Rocks. 8vo, pp. 48, with plates. Quart. Jour. Geol. Soc. Lond., xiv, pp. 458–500.

H. DAUBER: Ermittelung krystallographischer Constanten und des Grades ihrer Zuverlässigkeit. Pogg. Ann., cvii, 267, 343, cviii, 439.

W. H. MILLER: On the employment of the Gnomonic Projection of the Sphere in Crystallography. L., E. and D. Phil. Mag. for July, 1859.

DAUBRÉE: Memoire sur la relation des sources thermales de Plombières avec les filous métalifères, et sur la formation contemporaine des zéolithes. Extrait du Bulletin de la Société Géologique de France, [2], xvi, p. 562–591.

A. KENNGOTT: Uebersicht der Resultate mineralogischer Forschungen im Jahre, 1858. 8vo, pp. 229. Leipzig, 1860.—This is a continuation of Dr. Kenngott's excellent reports, and contains a résumé of the results of mineralogical researches made in 1858. Its completeness, and the careful criticisms by Dr. Kenngott render it a most valuable auxiliary in the study of mineralogy.

F. HESSENBERG: Mineralogische Notizen, No. 3. 4to, pp. 32. Frankfurt, 1860.—This number of Hessenberg's mineralogical notices, contains contributions to the crystallography of the species lievrite, realgar, heavy-spar, calcite, sphene, anatase, crocoisite, and malachite.

*Descriptions of Species.**

ALBITE [p. 240, VI].—Analyses of albite, (1.) from Oberhalbstein in Graubunden by Desclabissac (Zeitsch. d. deutschen geolog. Gesell., x, 207). (2.) from Calveras County, California, associated with auriferous pyrites and native gold by F. A. Genth (this Journal, [2], xxvii, 249):

	$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	ign.	
1.	68·50	18·11	——	0·56	0·66	12·17			=100·00
2.	68·39	19·65	0·41	0·47	——	10·97	*tr.*	0·21	=100·10

ALLANITE [p. 208, I—VI].—Analyses of *orthite* (1.) from Arendal by Zettel (Ann. d. Chem. u. Pharm., cxii, 85). (2.) mean of four analyses of orthite from Suontaka in Finland by Mendeljef (Kopp's Jahresbericht, 1858, 703):

	$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	$\dot{M}n$	$\dot{C}e$	$\dot{L}a, \dot{D}i$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$	$\dot{N}a$	$\dot{H}$	$\ddot{C}$	
1.	32·70	17·44	16·26	0·34	3·92	15·41	11·24	0·90	0·51	0·24	2·47	0·28	=101·71
2.	48·0	2·4	34·8	——	3·3	ẏ 1·5	9·3	——	——	——	0·7	——	=100·00

* The paging refers to Dana's Mineralogy, and the Roman numerals, in many places added, to the preceding Supplements.

ANORTHITE [p. 234, II, VI].—Potyka (Pogg. Ann., cviii, 110) has found *anorthite* to be a constituent of the rock occurring associated with hornblende at the Konchekowskoi Kamen in the Urals. The sp. gr. in fragments was 2·731 (17·1° C.), in powder 2·7325 (16·8°). B.B. difficultly fusible. Only partially decomposed, and with gelatinization, by chlorhydric acid.

$\ddot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$	$\dot{N}a$	
45·31	34·53	0·71	16·85	0·11	0·91	2·59	= 101·01

corresponding very closely with the formula $\dot{C}a^3\ddot{S}i+3\dot{A}l\ddot{S}i$, or considering silica as SiO_2=$\dot{C}a\ddot{S}i+\dot{A}l\ddot{S}i$.

Anorthite from Carlingford, Ireland, gave on analysis by Prof. Haughton, $\ddot{S}i$ 45·87, $\dot{A}l$ 34·73, $\dot{C}a$ 17·10, $\dot{M}g$ 1·55=99·25 (Greg, L., E. and D. Phil. Mag., [4], xix, 13).

ANTIGORITE [p. 281, I, IV].—For description of optical properties of, see Haidinger's article in Pogg. Ann., lxxvii, 94, and Descloizeaux, Ann. des Mines, xiv, (1858.)

APATITE [p. 396, I—VII].—A description of crystallized *apatite* from Pfitsch-Thal in Tyrol is given by G. vom Rath.—Pogg. Ann., cviii, 353.

ATACAMITE [p. 138, I, III, IV, V].—Bibra gives for the composition of *atacamite* from Algodan Bay in Bolivia:

$\dot{C}u$	Cu	Cl	$\dot{H}$	$\ddot{S}i$	
56·00	14·54	16·11	12·13	0·91	= 99·60

—Kopp's Jahresbericht, 1858, 740.

ARAGONITE [p. 448, II, III, IV, V, VII].—Luca has described a variety of aragonite, occurring in the Lias of Gerfalco in Tuscany, which he calls *mossottite*. The mineral is a prismatic fibrous radiated aggregate of a light green color. Sp. gr.= 2·884. On heating crumbles and loses its color. Composition:

$\dot{C}a$	$\dot{S}r$	$\ddot{C}$	$\dot{C}u$	$\dot{F}e$	Fl	$\dot{H}$	
50·08	4·69	41·43	0·95	0·82	*tr.*	1·36	= 99·33

According to Marcel de Serres, the same variety of aragonite occurs in the province of Messina.—(Kopp's Jahresbericht, 1858, 732.)

A variety of aragonite from Nertschinsk has been named *oserskite* by Breithaupt (B. and H. Zeit., xvii, 54).

AXINITE [p. 213].—This species has been observed at Cold Spring in New York.

BISMUTH [p. 20].—A specimen of *native bismuth*, associated with native gold, from the Peak of Sorato, analyzed by F. A. Genth (this Jour., [2], xxvii, 247) contained:

Bi	Te	Fe	
99·914	0·042	*tr.*	= 99·956

BORACITE [p. 393, II, III, IV].—The identity in chemical composition of *boracite* and *stassfurthite* was shown by Chandler (Suppl. IV), and is further confirmed by the analyses of Siewert and Drenkmann (Zeitschrift f. d. ges. Naturwissen, xi, 365, in Kopp's Jahresbericht, 1858, 735). The direct determinations made on the washed and ignited mineral in seven partial analyses gave as the mean:

$\dot{M}g$	$\dot{F}e$	$\ddot{B}$	
30·83	0·32	69·05	= 100·20

But H. Ludwig found (Arch. Pharm., [2], xcvi, 129, in Kopp's Jahresbericht, 1858, 735) that the unwashed air-dried stassfurthite contained

MgCl	$\dot{M}g$	$\ddot{B}^a$	$\dot{H}$
11·75	23·80	58·45	6·00

(*a*) By the difference.

A direct determination of $\ddot{B}$ gave 59·72 p. c., and Ludwig considered it a hydrous boracite containing a variable mixture of chlorid of magnesium. Heintz, however, has shown that chlorid of magnesium is an essential constituent of the mineral and that even after long washing with hot water it still contains a considerable amount of this chlorid. His results (calculated from five partial analyses) gave (Jour. f. prakt. Chem., lxxvi, 243):

Cl	Mg	Ṁg	Ḟe	B̈	Ḧ		
8·14	2·84	25·74	0·43	61·22[a]	1·63	=	100

a By the difference.

from which he draws the formula $2(\dot{M}g^3\ddot{B}^4)+MgCl, \dot{H}$. In communicating these observations of Heintz to the Berlin Academy, H. Rose (loc. cit.) adds that the boracite from Lüneberg also contains chlorine as an essential constituent, and this has been substantiated by the recent analyses of Dr. Julius Potyka (Pogg. Ann., cvii, 433), and also by Heintz (Jour f. prakt. Chem., lxxvii, 338).

Potyka analyzed both boracite and stassfurthite, and four analyses of boracite are given by Heintz, having been made under his direction by Siewert and Geist. The results are as follows:

	MgCl	Ṁg	Ḟe	B̈	Ḧ	
1. Clear boracite crystals,	10·90	25·24	1·59	62·91	0·55=101·19	Potyka.
2. Clouded " "	10·41	26·19	1·66	61·19	0·94=100·39	"
3. Stassfurthite,	10·73	26·15	0·40	60·77[a]	1·95=100·00	"
4. Boracite,	11·14	26·00	1·52	61·34[a]	—=100·00	Siewert.
5. "	11·71	24·86	1·13	62·30[a]	—=100·00	"
6. "	11·11	25·45	1·83	61·61[a]	—=100·00	Geist.
7. "	11·54	25·43	1·05	60·98[a]	—=100·00	"

a. By the difference.

Potyka's specimens, after pulverization, were washed with cold water until the wash water no longer gave any reaction with nitrate of silver or chlorid of barium; he found that both boracite and stassfurthite were slightly soluble in hot water. All the specimens of boracite were from Lüneberg. Heintz was unable to find a weighable quantity of water. Both Potyka and Heintz express the composition of boracite by the formula $2(\dot{M}g^3\ddot{B}^4)+MgCl=\ddot{B}$ 62·50, Ṁg 26·86, MgCl 10·64=100. Stassfurthite appears to be a boracite with one atom of water, $2(\dot{M}g^3\ddot{B}^4)+MgCl, \dot{H}=\ddot{B}$ 61·27, Ṁg 26·33, MgCl 10·42, Ḣ 1·98=100.

Bromyrite [p. 93].—F. Field has analyzed the *bromyrite* which occurs in octahedrons imbedded in carbonate of lime at Chañarcillo in Chile (Quar. Jour. Chem. Soc., x, 241). The crystals had the color and lustre of amber, and are much harder than the chloro-bromids or chlorid, and appear to be little affected by light. Composition,

Ag	Br		
57·43	42·57	=	Ag Br

Cancrinite [p. 233, II].—P. v. Pusirewsky has analyzed the *cancrinite* from the Ilmen Mts. and from Mariinskaja in the Tunkinsk Mts. (Kokscharow, Mat. Min. Russlands, iii, 76):

	S̈i	Ä̈l	Ḟe	Ṅa	Ċa	C̈	Ḧ	S̈	
1. Ilmen Mts.,	35·71	29·58	—	18·78	5·56	5·56	3·76	0·32	=99·27
2. " "	36·21	29·56	0·19	18·27	5·81	5·54	3·64	—	=99·22
3. Tunkinsk Mts.,	37·72	27·75	—	21·60	3·11	5·61	4·07	—	=99·86

The variety from the Ilmen Mts. had a light rose-red color and sp. gr.=2·489. That from Mariinskaja was yellow, sp. gr.=2·454. Pusirewsky writes the formula $2(\dot{N}a^2\ddot{S}i+2\ddot{A}l\ddot{S}i+[\dot{N}a, \dot{C}a]\ddot{C})+3\dot{H}$, containing one atom more of water than the formula given by Whitney for the cancrinite of Litchfield, Maine.

Carnallite [III].—Heintz gives the composition of *carnallite*, as found by Siewert:

MgCl	KCl	NaCl	Ċa S̈	Ḧ
36·03	27·41	0·23	1·14	36·33—38·01

—Kopp's Jahresbericht, 1858, 739.

Cassiterite [p. 118, V, VI, VII].—In a recent letter (Boston, Jan. 8th, 1860) to Prof. B. Silliman, Jr., Dr. C. T. Jackson mentions having received from Los Angelos in California a so-called silver ore, which on examination proved to be oxyd of tin mixed with some peroxyd of iron. On assay it gave 60·5 per cent of metallic tin. From the size of the masses of ore, Dr. Jackson is led to suppose that a vein of workable maguitude exists, some specimens being eight inches in thickness.

CERITE [p. 312].—Rammelsberg (Pogg., cvii, 632) has published several analyses of this species. The mean of the results gives—

Si	Ce	La, Di	Ca	Fe	H
19·18	64·55	7·28	1·35	1·54	5·71=99·61

from which he draws the formula $(Ce, La, Di, Ca, Fe)^2Si+Aq$, or R^2Si+Aq. An important fact observed by Rammelsberg is, that when cerite is treated with chlorhydric acid it is partially decomposed, leaving an insoluble residue of a different composition from that contained in the solution. He remarks that it appears as if cerite was composed of a mixture of silicates, differing in not being equally acted upon by acids.

CINNABAR [p. 48, II, IV, V].—Hugo Müller has analyzed and described tetrahedral crystals of cinnabar, from Asturia, Spain, which he supposes to be pseudomorphs of either tetrahedrite or chalcopyrite.—Quar. Jour. Chem. Soc., xi, 240.

CHLORITE [p. 294, IV, V].—For analyses of a chlorite-like substance from the melaphyr-porphyry of Ilfeld by Streng, see Zeitschrift d. deutschen geolog. Gesellschaft, x, 136.

CHRYSOCOLLA [p. 309, II].—P. Herter gives analyses of two varieties of chrysocolla from the crystalline slates of Ober and Nieder-Rochlitz in Transylvania, in Zeitsch. d. deutschen geolog. Gesellschaft, ix, 372. In the same paper Herter mentions a mineral which he considers a new species. It occurs in a geode of quartz. It is amorphous; brittle; color dark pistachio-green to liver-brown and dirty yellowish-green; has a strong pitchy lustre and an almost conchoidal fracture. Sp. gr.= 2·991. Contains $\ddot{S}i$ 14·24, SbO_5 24·68, $\ddot{A}s$ 7·24, $\dot{C}u$ 31·49, $\dot{P}b$ 0·68, $\dot{A}g$ 2·05, $\dot{F}e$ 8·38, $\dot{C}a$ 2·16, $\dot{M}g$ 0·56, $\ddot{A}l$ 0·21, $\ddot{H}$ 8·03=99·71. Another specimen gave but 16 per cent copper, showing the composition to be variable. In matrass gives water. Fuses easily in the forceps coloring the flame emerald green, with soda on charcoal gives a metallic bead. The centre of several of the masses was found to contain tetrahedrite, of which the above substance is a product of decomposition.

CLAYITE, *W. J. Taylor* (Proc. Acad. Nat. Sci., Philad., Nov. 1859.).—This mineral is a sulphid of lead, with about twenty-five per cent of arsenic, copper and antimony, and appears to be intermediary between galena and cupro-plumbite. It is from Peru, and occurs in small monometric crystals, a combination of the tetrahedron with the dodecahedron. It is also found amorphous, forming a coating a thirty-second of an inch thick on a layer of quartz. Color and streak blackish-gray; sectile; hardness about 2·5. B.B. on charcoal fuses easily, giving reactions for lead, arsenic and antimony, and with soda a brilliant metallic globule which becomes lustreless on cooling. Carefully selected crystals gave—

	S	As	Sb	Pb	Cu	Ag
1.	8·22	9·78	6·54	68·51	7·67	*tr.*
2.	8·14	——	——	67·40	5·62	——

No. 2 was not entirely free from extraneous matters. Prof. Taylor gives the formula $(Pb, \dot{C}u)(S, As, Sb)$. A confirmatory result was obtained on a specimen of the amorphous variety. The mineral was received from Joseph A. Clay, Esq., of Philadelphia, having been sent to him by his brother, Hon. J. Randolph Clay, United States Minister in Peru, and it is named in honor of these gentlemen. [The amount of sulphur is extremely small, and the presence of arsenic and antimony seems to indicate an analogy with *steinmannite*, which has recently been shown to be a galena, containing some twenty or more per cent of the sulphids of arsenic, antimony and zinc, although this composition varies exceedingly.—G. J. B.]

COAL [p. 26, II, IV, VI].—O. Matter has analyzed (Jour. f. prakt. Chem., lxxvii, 39) the so-called Bog-head coal from Torbane-Hill in Scotland, with the following result:

C	H	N	O	S	$\ddot{H}$	$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	$\dot{C}a$
60·81	9·18	0·78	4·39	0·32	0·39	13·19	9·50	1·22	0·27=100·05

CONDURRITE [p. 36, V].—An examination of this mineral by C. Winkler (B. u. H. Zeit., xviii, 383) confirms the results obtained by v. Kobell and Rammels-

berg, showing this mineral to be a mixture of arsenolite, cuprite, copper-glance, and arsenid of copper.

COPPERAS [p. 380].—A cupriferous variety of copperas from a mine of chalcopyrite in Turkey has been analyzed by Pisani (Comptes Rendus, April 18, 1859). Color like that of cyanosite, on exposure assumes an ochreous tint. Composition—

Ċu	Ḟe	S̄	Ḣ
15·56	10·98	29·90	43·56

giving the formula (Ḟe Ċu)S̄+7Ḣ, or copperas in which a portion of the iron is replaced by copper.—(L. E. and D. Phil. Mag., [4], xvii, 409.)

COPPER NICKEL [p. 52, VI].—According to G. Rose and Nöggerath the copper-nickel from Sangerhausen crystallizes in the hexagonal form.—(Zeitschrift d. deutschen geolog. Gesellsch., x, 91; Verhandl. d. naturhist. Ver d. Rheinlande, xv, xv.)

CYANOLITE, CENTRALLASSITE, CERINITE. *H. How*, (Ed. new Phil. Jour., x, 84).—Prof. How has described three new species of silicates occurring in a reniform nodule in the trap of the Bay of Fundy, one mile east of Black Rock. The nodule was about half the size of a fist. It was covered with a green chlorite-like coating, and on breaking it presented a curious internal structure; immediately beneath the coating was a narrow band of a yellowish-white mineral resembling wax (*cerinite*), then a portion having a stellated appearance and a highly pearly lustre (*centrallassite*), while the centre was principally made up of a bluish-gray opaque mineral in rounded spots (*cyanolite*). A careful separation of the constituents showed—1. *Cyanolite*, comprising the centre of the nodule, was amorphous; hardness=4·5; sp. gr.=2·495; fracture flat-conchoidal, even; streak white, lustre dull, color bluish-gray; sub-translucent in thin pieces, and the powder transparent under the microscope. Decomposed with chlorhydric acid, affording slimy silica, but does not gelatinize either before or after heating. In matrass becomes white and gives off water. B.B. in platinum forceps fuses only on the thin edges, with soda and borax gives transparent beads, with salt of phosphorus a translucent glass. Analysis gave—

	S̄i	Ǟl	Ċa	Ṁg	K̇	Ḣ	
1.	74·15	0·84	17·52	*tr.*	0·53	7·39	= 100·43
2.	72·52	1·24	18·19	*tr.*	0·61	6·91	= 93·47

Analysis No. 2 was made on a specimen not perfectly free from *centrallassite*. Disregarding the small amount of alumina and potash in No. 1, we have the oxygen ratio Ċa : S̄i : Ḣ as 1 : 7·85 : 1·31 or 4 : 31·40 : 5·2, from which Prof. How draws the formula $Ca^4Si_{10}+5H=Si$ 74·26, Ċa 18·36, Ḣ 7·37. Considering the water as basic the ratio of the oxygen in all the bases to that of the silica is as 1 : 3·2, approximating to that of Edelforsite, Ċa S̄i or 1 : 3. The name *cyanolite* is in allusion to the blue tint which distinguishes this mineral from its associates.

2. *Centrallassite* occurs in spherical concretions between the cyanolite and the rind. The concretions when broken have a lamellar structure and consist of plates diverging from a centre; the plates have a pearly lustre, but the mineral passes into an opaque white form. Centrallassite has a white, sometimes yellowish, color; translucent, transparent in thin plates; brittle; lustre sub-resinous; hardness=3·5; sp. gr.=2·45—2·46. In matrass yields water, becomes opaque and silvery-white. B.B. fuses readily, with spirting, to an opaque glass, with the fluxes gives a clear bead. Decomposed by chlorhydric acid without gelatinizing. The result of two analyses were:—

S̄i	Ǟl	Ċa	Ṁg	K̇	Ḣ	
59·05	1·00	27·86	0·20	*undet.*	11·40	
58·67	1·28	27·97	0·13	0·59	11·43	= 100·07

The oxygen ratio of the mean of these analyses for the lime, silica and water is 1 : 3·91 : 1·27=4 : 15·64 : 5·08, from which Prof. How deduces the formula $Ca^4Si_{15}+5H=Si$ 59·06, Ċa 29·20, Ḣ 11·74. From two determinations of the water and an estimation of the silica, the opaque mineral was proved to have the same composition as the transparent variety.

3. *Cerinite.* The narrow band enveloping the two preceding minerals (an eighth of an inch in thickness) was an opaque mineral, translucent in very thin fragments; amorphous; lustre sub-resinous, resembling white or yellowish-white wax; H.=3·5. B.B. fusible without intumescence. It was imperfectly decomposed by chlorhydric acid. Two analyses gave—

	$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$	$\dot{H}$
1.	58·13	12·21	1·01	9·49	1·83	0·37	15·96=99·00
2.	57·02	13·11	1·27	10·15	1·91	*undet.*	15·42=98 88

The iron and potash in No. 1 were dissolved out by chlorhydric acid—a fusion with carbonate of soda was made to complete the decomposition. The loss in the analyses is supposed by Prof. How to be due to alkali not determined. The ratio between $\dot{R}$, $\ddot{R}$, $\ddot{S}i$, $\dot{H}$ is as 1 : 2 : 9 : 4, and gives the formula $3\dot{C}a\ddot{S}i+2\dot{A}l\ddot{S}i^3+12\dot{H}=$ $\ddot{S}i$ 58·06, $\dot{A}l$ 14·60, $\dot{C}a$ 11·96, $\dot{H}$ 15·38.

Datholite [p. 334, I—IV, VI].—J. D. Whitney has described a peculiar variety of this mineral, which occurs in nodules in the Minnesota mine, Lake Superior (this Jour. [2], xxviii, 13). The mineral is quite compact and breaks with a conchoidal fracture; it is perfectly white and opaque, resembling in physical character the purest and most close-grained marble. H.=4·5; sp. gr. 2·983. Analysis by C. F. Chandler gave—

$\ddot{S}i$	$\dot{F}e, \dot{A}l$	$\dot{C}a$	$\ddot{B}$ (loss)	$\dot{H}$
37·41	0·35	25·11	21·40	5·73 = 100.

Q. Sella has in his collection, a crystal of datholite from Baveno, 4½ inches long by 3½ inches broad, and 1½ inches in thickness.—(Wien Akad. Berichte, xxix, 239.)

Diaspore.—See under *Natrolite.*

Embolite [p. 93].—F. Field has given analyses of three varieties of chloro-bromid of silver from Chañarcillo, in the province of Atacama (Quar. Jour. Chem. Soc., x, 239):

	Ag	Br	Cl	
1.	68·22	16·84	14·92	= 99·98
2.	66·94	19·82	13·18	= 99·94
3.	61·07	33·82	5·00	= 99·89

No. 1 had a pale green color, and its formula is 2AgCl+AgBr. No. 2, of a darker color, and of more frequent occurrence, is identical with Breithaupt's *embolite*, as analyzed by Plattner, 3AgCl+2AgBr. No. 3 was of a very dark green color, sometimes having a purple tint, its formula is AgCl+3AgBr.

Under the names *megabromite* and *mikrobromite* Breithaupt has described two new chloro-bromids of silver (B. u. H. Zeit., xviii, 449). I. *Megabromite.* Lustre adamantine; color siskin to pistachio-green, changing on exposure to the light, to blackish-gray; streak pale green. Crystalline form cubic; cleavage cubic, though not always distinct; fracture conchoidal and uneven; slightly malleable and sectile. H=2·75—3; sp. gr. 6·230—6·234. Occurs in compact limestone. Analysis by T. Richter:

Ag	Br	Cl	I
64·19	26·49	9·32	*tr.*

The relations of Ag, Br and Cl are as 2·26 : 1·26 : 1, or as 9 : 5 : 4=1AgCl+5AgBr. It bears a very strong resemblance to embolite in physical characters.

II. *Mikrobromite.* Lustre adamantine; color between asparagus and greenish-gray, on exposure becomes ash-gray and opaque; streak white, translucent; crystalline form, cubic; fracture irregular, and without any regular cleavage; very sectile and malleable. H.=2·5—3. Sp. gr. 5·75—5·76. Occurs with native silver in a yellowish-red compact limestone at Copiapo in Chile. Two analyses by Richard Müller gave—

	Ag	Br	Cl
1.	70·28	12·35	17·37
2.	69·81	12·44	17·75

The ratio of Ag, Br and Cl is as 4 : 1 : 3, giving the formula AgBr+3AgCl.

[In this connection it may be interesting to notice the remarks of Domeyko upon the chloro-bromids of silver (Elementos de Mineralogia, 202). He says: "the chloro-bromids vary in color, from grayish-green or yellow, to asparagus and pistachio-green. In general the specimens that have a yellow color have more bromine, and consequently less silver, than those of a gray or pearly green color." Analyses of three specimens of the yellow variety from the mines of Chañarcillo gave Domeyko:

	AgCl	AgBr		Ag	Br	Cl
1.	51·00	49·00	=	66·53	20·85	12·62
2.	52·80	47·20	=	64·84	20·09	13·07
3.	51·00	49·00	=	66·53	20·85	12·62

The ratio of the atoms of Ag, Br and Cl in Nos. 1 and 3, are as $2\frac{1}{2} : 1 : 1\frac{1}{2}$ or 7:3:4, giving the formula 4AgCl+3AgBr. No. 2 has the ratio $2\frac{1}{2} : 1 : 1\frac{1}{2}$ or 5 : 2 : 3, giving the same formula as Breithaupt's embolite, 3AgCl+2AgBr. Domeyko also gives four analyses of the grayish green variety which occurs in masses an inch or more in thickness. Of these Nos. 4, 5 and 6, as analyzed below, were from Chañarcillo and 7, from Quillota. All the specimens examined were remarkably homogeneous and pure, some of them as translucent as wax.

	AgCl	AgBr		Ag	Br	Cl	Ratio.
4.	72·9	27·1	=	70·44	11·53	18·03	9 : 2 : 7
5.	65·6	34·4	=	69·14	14·63	16·23	7 : 2 : 5
6.	81·4	18·6	=	71·94	7·92	20·14	20 : 3 : 17
7.	66·4	33·6	=	69·28	14·30	16·42	15 : 4 : 11

If we now recapitulate these together with Field's analyses and the analyses of the three species of Breithaupt, in the order of the increase of bromine, we have:

	Ag	Br	Cl	
Pearly green, Chañarcillo, (6),	71·94	7·92	20·14	Domeyko.
" " " (4),	70·44	11·53	18·03	"
Mikrobromite, Copiapo,	69·84	12·39	17·77	Müller.
Pearly green, Quillota, (7),	69·28	14·30	16·42	Domeyko.
" " Chañarcillo, (5),	69·14	14·63	16·23	"
Light green, "	68·22	16·84	14·92	Field.
Embolite, "	66·94	19·82	13·18	"
" "	66·86	20·08	13·05	Plattner.
" " (2),	66·84	20·09	13·07	Domeyko.
Yellow, " (1 and 3),	66·53	20·85	12·62	"
Megabromite,	64·19	26·49	9·32	Richter.
Dark green, Chañarcillo,	61·07	33·82	5·00	Field.

Here then are ten distinct chemical compounds formed by the union of various proportions of AgCl and BrCl, and so far as known, they all crystallize in the monometric system. As both *bromyrite* (AgBr) and *kerargyrite* (AgCl) crystallize in the monometric system, and as Cl and Br are isomorphous and may replace each other in an infinite number of proportions, it is well to ask, where we shall stop in the making of new species. The five varieties which we have quoted from Domeyko, together with the two varieties analyzed by Field, deserve to rank as species quite as much as embolite, megabromite, and mikrobromite. The varieties of chloro-bromid of silver seem to shade insensibly into each other—the specific gravity increases, and the color deepens in proportion with the increase of bromine. We have already the name embolite admitted in the science, and if the native chloro-bromid should be found which has the ratio 2 : 1 : 1 or AgCl+AgBr, it would have the same right to be ranked a species as dolomite, but we protest against making ten or more species of Ag (Br, Cl), for the same reasons that we should protest against making distinct species of all of the varieties of dolomitic limestone.—G. J. B.]

FERGUSONITE [p. 350, III].—R. Weber has analyzed *fergusonite* from West Greenland (Pogg. Ann., cvii, 590):

Cb	Sn	Zr	Y	Ce	Fe	U	
48·84	0·35	6·93	38·61	3·05	1·48	0·35	= 99·61

This, although differing somewhat from the former analysis by Hartwall, proves the mineral to be distinct from the Norwegian *tyrite*.

FRANKLINITE [p. 166, I, VII].—The chemical composition of this mineral has been carefully studied by Rammelsberg (Pogg. Ann., cvii, 312), and the causes of error, and the disagreement in former analyses pointed out. His analyses, partly from massive, and partly from crystallized specimens, gave:

		1.	2.	3.	4.	5.
G.=5·21	Ḟe	64·28	65·32	64·92	63·40	64·64
	Ṁn		13·08	13·87	13·28	13·81
	Żn			25·09	26·83	25·51
				103·88	103·51	103·96

Analyses 4 and 5 were made by Schulz in Rammelsberg's Laboratory. The mean is Ḟe 64·51, Ṁn 13·51, Żn 25·30 (excluding Żn in No. 4) =103·52, equal to

	Fe	Mn	Zn	O	
	45·16	9·38	20·30	25·16	= 100·00
Equivalents,	4·8	1·	1·8	9·3	

The atomic proportion between the metals and the oxygen is 7·6 : 9·3=1 : 1·2=5 : 6 or R^5O^6. Rammelsberg proves by experiment that at least a *portion* of the manganese must be sesquioxyd, and after the consideration of several hypotheses in regard to the oxydation of the iron and manganese, which show the impossibility of the composition of the mineral corresponding to the spinel formula, he is led to assume the *whole* of the manganese to exist as sesquioxyd. He then calculates the oxygen remaining, after deducting that united with the zinc and manganese, as belonging to the iron. This gives—

	a	Oxygen.		*b*	Oxygen.	
Ṁn	13·51	4·13	13·61	13·51	4·13	12·38
Ḟe	31·64	9·48		27·50	8·25	
Ḟe	29·55	6·55	11·55	33·31	7·38	12·38
Żn	25·30	5·00		25·30	5·00	
	100·00		25·16	99·62		24·76

Column *b* is a correction of the calculation so as to make the oxygen of the protoxyds and sesquioxyds equal, and corresponds to the amount of iron found in the analyses. The oxygen thus calculated differs but 0·4 per cent from the total oxygen.

The calculation of the compound R^5O^6 in which Mn : Zn : Fe=1 : 2 : 5 gives Fe 45·24, Mn 8·92, Zn 21·02, O 24·81, or Ḟe 64·66, Ṁn 12·80, ZnO 26·19=103·65, corresponding very well with the results of the analyses, and giving the formula $(\dot{F}eZn)^3(\dot{F}e\dot{M}n)$ or $\dot{R}^3\ddot{R}$. Rammelsberg considers the isomorphism of $\dot{R}\ddot{R}$ with $\dot{R}^3\ddot{R}$ as a necessary consequence of the isodimorphism of the oxyds $\dot{R}$ and $\ddot{R}$, already shown in his recent investigations on hornblende, augite, and the different varieties of specular and titanic iron. [An analysis of *franklinite*, made by the writer in the autumn of 1858, gave results agreeing very nearly with the composition obtained by Rammelsberg, viz. Ḟe 65·05, Ṁn 14·77, Żn 23·30, insoluble 0·30=103·12.—G. J. B.]

GALENA [p. 36, II—IV, VII].—The so-called *steinmannite*, already referred to galena by Kenngott (Uebersicht, 1855, 109), has recently been analyzed by Schwarz (*Reuss*, Wien. Akad. Ber., xxv, 561), with the following results:

PbS	As_4S_3	SbS_3	ZnS	FeS	
76·48	9·25	0·77	11·38	2·10	= 99·98

Another specimen gave 2 p. c. less lead, a trace of zinc, and scarcely any arsenic, but contained a large amount of antimony. In a third sample a small portion of silver was found. From these facts Prof. Reuss draws the conclusion that sulphid of lead is the only constant constituent, and that *steinmannite* is an impure galena.

GARNET [p. 190, I—VII].—Analyses of *lime-iron-garnet* from the Schischimsk Mts. (1.), and from Achmatowsk (2.), and the *grossular* from the Slüdianka River (3), made under the direction of N. v. Iwanow in the Mining-Department Laboratory in St. Petersburg gave (Kokscharow, Mat. Min. Russlands, iii, 79):

		$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{M}n$
1.	G.=3·798.	35·21	*tr.*	34·11	30·96	*tr.*	*tr.*=100·28
2.	———	37·22	6·04	24·81	31·07	0·49	*tr.*= 99·63
3.	G.=3·427.	40·99	14·90	10·94	32·94	0·98	—=100·75

An extended notice of the occurrence of *garnet* in Russia, with description of interesting crystals is given by Kokscharow in his Materialen zur Mineralogie Russlands, iii, 1—40.

GERSDORFFITE [p. 58, VII].—Dr. Genth has detected crystals of this mineral occurring as an incrustation upon partially decomposed galena and blende at Phœnixville, Pa. The crystals are cubes with octahedral planes, and sometimes, though rarely, pentagonal dodecahedrons are found.—This Jour., [2], xxviii, 248.

GLASERITE [p. 365, III].—Prof. W. J. Taylor refers to *glaserite*, with a query, a sulphate of ammonia and potash from the Chincha Islands. It occurs in concretions a half or three-quarters of an inch in diameter. Color yellowish-white; structure crystalline; taste pungent and bitter; opaque; permanent in air. Hardness 2. B.B. blackens and fuses with difficulty, giving a white bead. The results of two analyses were:

	$\dot{S}O_3$	$\dot{N}H^4O$	KO	NaO	
1.	48·40	5·37	43·45	1·68	= 98·90
2.	48·30	5·10	46·49		= 99·89

Both specimens contained traces of organic matter. The composition gives the formula $(\dot{N}H^4O, KO, NaO)\dot{S}O^3$, which differs from that of glaserite only in having a portion of the potash replaced by ammonia and soda (Proc. Acad. Nat. Sci. Philad., Nov., 1859).

HALLOYSITE [p. 251].—Nöggerath has described as a variety of opal, a mineral occurring in a soft gelatinous state in trachyte in the opal mine at Czerweitza in Hungary (Verhand. d. naturhist. Ver. d. Rheinlande, xv, cii). Upon exposure to the atmosphere the mineral hardens, and its characters approach those of jasper-opal. Analysis by Landolt showed the mineral to lose 5·30 p. c. by drying over sulphuric acid, and the dried substance gave:

$\dot{S}i$	$\dot{A}l\dot{F}e$	$\dot{C}a$	$\dot{H}$	
46·96	36·56	*tr.*	16·10	= 99·62

[Assuming the iron to be an unimportant ingredient, this composition corresponds to the varieties of *halloysite* from Anglar and Houssha (Min., p. 151, anal. 1, 2).—G. J. B.]

HAYESINE [p. 394, III, IV].—Analyses of very pure *hayesine* by Reichardt (Kopp's Jahresbericht, 1858, 737):

	$\ddot{B}^a$	$\dot{C}a$	$\dot{N}a$	$\ddot{S}$	$\dot{C}l$	Insol.	$\dot{H}^b$	$\dot{H}^c$
1.	52·05	11·56	*tr.*	0·53	0·94		33·53	1·38
2.	50·42	12·10	*tr.*	1·07	1·21	0·67	33·67	0·87

(*a*) by the difference. (*b*) expelled at a red heat. (*c*) expelled at 100° C.

No. 1 was a specimen from the German importers, and 2 was received direct from Lima. Reichardt gives the formula $\dot{C}a\ddot{B}^4+10\dot{H}$. An analysis of *hayesine* by F. W. Helbig (Dingler's Polytech. Jour., cxlvii, 319) gave $\ddot{B}$ 46·46, $\dot{C}a$ 14·03, $\dot{N}a$ 5·17, $\dot{H}$ 32·61, NaCl 1·89, $\dot{M}g$ and $\ddot{S}i$ traces. Additional analyses of the commercial article are given in Barreswil's Réperetoire de Chimie Appliquée, i, 215.

HEMATITE [p. 113, II, III, IV, VII].—A specimen of tabular crystalline hematite from Vesuvius analyzed by Rammelsberg (Pogg. Ann., cvii, 453) gave $\dot{F}e$ 98·05, $\dot{M}g$ 1·40=99·45. It contained no protoxyd of iron.

Analyses of hematite from the Lake Superior region by Prof. J. D. Whitney (this Jour., [2], xxviii, 13):

	I.			II.		III.	
	a.	*b.*	*c.**	*a.*	*b.*	*a.*	*b.*
Insoluble,	1·02	·80	·54	7·92	7·96	1·99	2·05
Iron,	69·41	70·22	69·96	64·42	64·01	68·81	
Oxygen and traces, lime, &c.,	29·57	28·98	29·50	27·66	28·03	29·20	

* Mean of three closely-agreeing determinations.

I. from the Jackson Mountain, II. from the Cleveland, and III. from the Burt or Lake Superior Mountain.

HOMICHLINE [VII].—This mineral was referred to *barnhardtite* in the last supplement, but the recent analysis of Richter, published by Breithaupt in the B. u. H. Zeitung, xviii, 321, gives its composition as Fe 25·81, Cu 43·76, S 30·21, and the formula $(Cu^2S)^3$, Fe^2S^3+2FeS. Sp. gr. 4·47—4·48, (Breithaupt.) [The identity of crystalline form of this mineral with chalcopyrite, together with its less degree of hardness, and the difficulty of obtaining it pure and free from admixture with chalcopyrite, would seem to indicate that it might be a product of decomposition of this latter species, or perhaps a mixture of this species, with some of the richer sulphids of copper, such as erubescite or copper-glance. It is interesting in this connection to note Dr. Genth's remarks upon the occurrence of barnhardtite with copper-glance and chalcopyrite at the Pioneer Mills mine (this Journal, [2], xxviii, 248). —G. J. B.]

HORNBLENDE [p. 170, I—IV, VI, VIII].—A. Knop has published a description and several analyses by himself and W. Hoffman of an interesting soda hornblende from the serpentine rock at Waldheim in Saxony (Ann. d. Chem. u. Pharn., cx, 363). Color leek-green; transiucent; occurring in veins of an inch in thickness and resembling actinolite. H.=5. Sp. gr. 2·957.

	$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	
1.	58·71[a]	1·52	5·65	0·25	11·53	10·01	12·38=100·05	Knop.
2.	58·45[a]	1·92	5·53	0·51	10·28	11·12	12·61=100·42	Hoffmann.
3.	58·45[a]	1·74	5·79	0·32	10·76	10·83	12·93=101·12	"

(*a.*) Mean of two determinations.

It lost 0·5 per cent by ignition. [The analyses give too much silica for the hornblende formula, but this may be accounted for on the supposition that the mineral was partially decomposed, when treated by hydrochloric acid to free it from adhering carbonates. The large percentage of soda is remarkable.—G. J. B.]

IODYRITE [p. 95, 506].—An analysis of iodyrite from Delirio's Mine, Chañarcillo, afforded F. Field, Ag 45·98, I 54·02=AgI.—(Quar. Jour. Chem. Soc., x, 241).

IRIDOSMINE [p. 19, I].—Analyses of *iridosmine* from various localities by Deville and Debray (Ann. Chim. et Phys., [3], lvi, 481).

		Ir	Rd	Pt	Ru	Os	Cu	Fe	
1.	Columbia,	70·40	12·30	0·10	—	17·20	—	—	=100·
2.	"	57·80	0·63	—	6·37	35·10[a]	0·06	0·10	=100·06
3.	California,	53·50	2·60	—	0·50	43·40	—	—	=100·
4.	Australia,	58·13	3·04	—	5·22	33·46	0·15	—	=100·
5.	Borneo,	58·27	2·64	0·15	—	38·94	—	—	=100·
6.	Russia,	77·20	0·50	1·10	0·20	21·00	*tr.*	—	=100·
7.	" G.=18·9,	43·28	5·73	0·62	8·49	40·11	0·78	0·99	=100·
8.	" G.=18·8,	64·50	7·50	2·80	—	22·90	0·90	1·40	=100·
9.	" G.=20·4,	43·94	1·65	0·14	4·68	48·85	0·11	0·63	=100·
10.	" G.=20·5,	70·36	4·72	0·41	—	23·01	0·21	1·29	=100·

(*a.*) In this analysis, the osmium was determined directly, in the others by difference.

IRON [p. 17, II, VII].—F. A. Genth describes in this Journal, [2], xxviii, 246, a specimen of what appears to be telluric iron. It is said to occur near Knoxville, in Tennessee, although its exact locality is not known. It contains neither carbon, phosphorus or sulphur, and its peculiar appearance together with its being associated with a silicate of magnesia, iron and lime, render it probable that it may be a genuine specimen of *native iron*. Dr. Genth describes the mass examined, to have been about one and a half inches square, and three-eights of an inch in thickness. The

iron had a grayish-white color, a hackly fracture, and broke easily into fragments, which though crystalline, did not show any distinct planes. It was soft, scarcely scratching fluor-spar. Lustre eminently metallic. Readily dissolved by nitric acid. Composition:—

Fe	Ni	Co	Mg	Ca	Si	
99·790	0·140	*tr.*	0·022	0·121	0·075	= 100·148

A similar mineral has been received by Dr. Genth from Northern Alabama, and it is exceedingly desirable that more definite information should be obtained in regard to the locality and mode of occurrence of this problematical substance.

KERARGYRITE [p. 92, IV].—A specimen of chlorid of silver from the "Republicana Mine," Chañarcillo, analyzed by F. Field (Quar. Jour. Chem. Soc., x, 239) contained:

Ag	Cl		
75·27	24·73	=	AgCl.

LABRADORITE [p. 237, II, VII].—Vom Rath gives as the composition of the *labradorite* from the gabbro of Marmorera in Graubündten:

	Si	Al	Fe	Ca	Mg	K	Na	
G.= 2·840.	55·45	22·12	4·28	9·68	1·30	1·64	5·73	=100·20

This mineral lost 2·76 p. c. on ignition.—Zeitsch. d. deutschen geolog. Gesellschaft, ix, 246.

LIBETHENITE [p. 420].—Analyses of *libethenite* from Congo in Portuguese Africa by Hugo Müller (1.) (Quar. Jour. Chem. Soc., xi, 242); from Libethen (2.) by Bergemann, and from Nischne-Tagilsk (3.) by Chydenius (Kopp's Jahresbericht, 1858, 726):

	Cu	P	As	H	Fe	O	
1. Congo,	67·21	28·76		4·03			=100·00
	66·76	29·02		4·22			=100·00
2. Libethen,	66·29	26·46	2·30	4·04			= 99·09
3. Nischne-Tagilsk,	64·47	29·48	*tr.*	3·68	1·77	0·82	=100·22

LILLITE, *Reuss* (Wien Akad. Ber., xxv, 550).—This name has been given by Reuss to a mineral which occurs at Przibram in Bohemia. In physical characters it resembles glauconite, and appears to be a product of the decomposition of pyrites. It is an amorphous, lustreless, earthy substance, having a hardness = 2, and sp. gr. 3·043. Color blackish-green, in very fine powder under the microscope is leek-green by transmitted light. Material selected as pure as possible gave Payr on analysis:

Si	Fe	CaC	FeS (insol.)	H	
32·48	54·95	1·96	0·63	10·20	= 100·22

On treating the mineral with nitric acid, Payr found after ignition and making allowance for the water, the sulphur of the pyrites, and the carbonic acid, that the iron in the mineral had absorbed 3·43 per cent of oxygen, so that deducting this from the 54·95 Fe we have 51·52 per cent of iron plus oxygen. This gives a total of 96·79, a loss of 3·21 per cent in the analysis. The author places the species near hisingerite and cronstedite. It corresponds very closely in chemical composition with the variety of hisingerite from Riddarhyttan in which Rammelsberg found (Min., p. 290):

Si	Fe	Fe	Ca	Mg	H
33·07	34·78	17·59	2·56	0·46	11·54

MAGNESITE [p. 447, II, III].—Analyses of the magnesite from Snarum and Frankenstein by T. Scheerer (Jour. f. prakt. Chem., lxxvi, 424):

	C	Mg	Fe	Ca	
Snarum (crystallized),	52·13	46·66	0·78	0·43	= 100·00
Frankenstein (amorphous),	55·34	47·43	—	0·22	= 100·00

The small amount of mechanical mixture, amounting in the Snarum specimen to 0·05—0·1405 per cent, and in the Frankenstein specimen to 0·048 p. c., have been subtracted from the above.

MAGNOFERRITE.—Rammelsberg (Pogg. Ann., cvii, 451) gives this name to the octahedral iron which occurs interlaminated with hematite, in the fumaroles formed at Vesuvius after the eruption of 1855. His former analyses showing the presence of a considerable amount of magnesia are contained in Suppl. VII. Two additional analyses of portions selected out by means of the magnet from the finely pulverized mineral gave:

	Ḟe	Ṁg	Ċu	Insol.
1. G.=4·568.	82·91	13·60	0·99	2·51 = 100·01
2. G.=4·638.	83·30	13·41	0·59	2·00 = 99·30

which, excluding the oxyd of copper and insoluble portions, gives (1.) Ḟe 85·92, Ṁg 14·09=100·01, and (2.) Ḟe 85·51, Ṁg 13·77=99·28.

The former analyses (Suppl. VII) thus calculated are: *a*. Ḟe 86·96, Ṁg 12·59= 99·55; *b*. Ḟe 84·20, Ṁg 16·00=100·20; *c*. Ḟe 84·35, Ṁg 15·65=100. Analysis *a* was made from selected crystals, *b* was a portion extracted by the magnet from the associated hematite, while *c* was a specimen thus selected from one of the older Vesuvian hematites. Rammelsberg considers the composition of the crystals as $\dot{M}g^m\dot{F}e^n$ in which probably $m=3$ and $n=4$, the regular (monometric) form being due to the isodimorphism of Ṙ and R̈.

MARGARODITE [p. 223].—An analysis of an authentic specimen of margarodite from the original locality at Pfitsch gave Hlasiwetz (Kenngott's Uebersicht, 1858, 67):

S̈i	Ä̇l	Ḟe	Ċa	K̇	Ṅa	Ign.
45·48	33·80	6·25	0·48	7·31	6·22	0·36 = 99·90

Kenngott remarks that this composition may be represented by the formula $\dot{R}\,\ddot{S}i + 2\ddot{R}\,\ddot{S}i$, but adds that this is of little value, as on closer examination with the magnifier, the specimen proved to be an intimate mixture of a mica with granular quartz and minute crystals of feldspar. [The mica from Lane's Mine, analyzed by Smith and myself, and referred by Dana to margarodite, is distinctly foliated and apparently perfectly homogeneous. It is identical in composition with the so-called margarodite from St. Etienne analyzed by Delesse (Min., p. 224).—G. J. B.]

MARIONITE (*Elderhorst*), see *Zinc-bloom*.

MEGABROMITE (*Breithaupt*), see *Embolite*.

MIKROBROMITE (*Breithaupt*), see *Embolite*.

MISPICKEL [p. 62, 509, I, II, III, V].—Analyses of mispickel from Sahla in Sweden by J. Potyka (Pogg. Ann., cvii, 304):

	S	Fe	As	Sb	Bi
G.=6·095.	19·13	34·78	43·26	1·29	0·14 = 98·60

These results give the received formula, $FeAs_4+FeS_2$, differing from the analysis by Behncke (Suppl. III), which corresponded to $3FeS^2+2Fe^2As^3$. Potyka shows the want of agreement between the analyses to be due to the fact that mispickel suffers partial decomposition by simply boiling in water. The sp. gr. of small fragments he found to be 6·043—6·047, that of the powder boiled for some time in water was only 5·819 to 5·874, and on examination of the water appreciable quantities of sulphuric acid, iron and arsenic were found in solution.

C. v. Hauer obtained in two analyses of mispickel from Kindberg in Styria:

S̈i	Ä̇l	Ċa	Fe	As	S
5·0	1·0	0·3	30·8	43·2	18·9 = 99·2
0·7	0·3	*tr.*	32·7	45·0	21·0 = 99·7

—Jahrb. d. k. k. geolog. Reichsanstalt in Kopp's Jahresbericht f. 1858, p. 678.

According to Daubrée (Compt. Rendus, 1858, xlvii, 959) the lignite of the tertiary formation at Lobsann (Lower Rhine) contains from 0·002—0·0008 per cent of arsenic, and on dissolving the bituminous limestone from the same locality a fine amorphous residue (amounting to about 2 p. c.) is obtained, which gives the reactions of mispickel.

MOLYBDATE OF IRON [p. 144, I, II].—The so-called *molybdate of iron* described by D. D. Owen has recently been examined by Dr. Genth (this Jour., [2], xxviii, 248), and from the varying proportions of the iron—in one case 35 p. c., in another 24·3—he questions whether the substance may not be a mechanical mixture of molybdine and limonite.

MOSSOTTITE.—See *Aragonite.*

NAGYAGITE [p. 65].—Folberth has analyzed the foliated-tellurium from Nagyag. It occurs in six-sided tables in a pearl-gray quartz, and has a specific gravity =6·68. Treatment with sulphid of carbon extracted 25 p. c. of the amount of sulphur. Two analyses gave (Verhandl. d. siebenbürg. Ver. f. Naturwissensch., viii, 99, in Kenngott's Uebersicht f. 1856–7, 179):

Pb	Au	Sb	S	Te	Se
60·83	5·84	3·69	9·76	17·22	*tr.* = 97·34
60·27	5·98	3·86	9·68	18·04	*tr.* = 97·83

differing very materially from the previous analyses by Klaproth, Brandes and Schönlein.

NATROLITE [p. 327, VI, VII].—A variety of transluscent natrolite from Fassa in Tyrol, analyzed by Hlasiwetz, gave the following composition (Kenngott's Uebersicht, 1858, 72):

$\ddot{S}i$	$\ddot{A}l$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{H}^a$	$\dot{H}^b$
43·34	27·43	3·60	0·40	9·00	10·30	0·90 = 99·97

(*a*) basic water. (*b*) hygroscopic water.

agreeing very nearly with the composition of galactite, which has been shown to be a variety of natrolite by Dana and Heddle (Suppl. I and III).

In an article upon *Spreustein* (natrolite) (Pogg. Ann., cviii, 431) Scheerer shows the cause of color, of the red and brown varieties of this mineral, to be due to mechanical impurities. A microscopical examination of several varieties showed that only the perfectly white specimens were entirely free from mechanical mixture. The white varieties were perfectly decomposed by chlorhydric acid giving a homogeneous jelly, while with the colored varieties the gelatinized mass always contained suspended more or less of an opaque white powder. If however, the decomposition was made with nitric acid, this powder retained the original color of the natrolite. A separation of the insoluble powder on some twenty grams of the mineral gave material to determine the character of this substance. The results of two analyses prepared from different varieties gave:

	$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	$\dot{H}$
1.	1·58	76·75	6·77	14·70 = 99·80
2.	0·82	82·56	1·52	15·00 = 99·90

These give the formula $\ddot{R}\ddot{H}$, and the powder is *diaspore* in which a portion of the alumina is replaced by iron. The quantity of this mineral in the specimens of natrolite analyzed by Scheerer varied from 4 to 7 p. c. This will explain the reason of the different analyses of Spreustein differing from each other, and also from pure natrolite. The following analyses may serve as examples. I. Crystallized colorless natrolite from Brevig analyzed by Dr. Sieveking in Scheerer's laboratory. II. Dark brownish-red Spreustein from an island of Brevigfjord, by Scheerer.

	$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{N}a$	$\dot{H}$
I.	47·16	26·13	0·53	0·53	15·60	9·47 = 99·42
II.	44·50	30·05	0·98	0·83	13·52	9·93 = 99·81

II. contained 6⅔ p. c. of diaspore, which when subtracted from the above gave $\ddot{S}i$ 47·47, $\ddot{A}l$ 26·83, $\dot{F}e$ 0·60, $\dot{C}a$ 0·88, $\dot{N}a$ 14·42, $\dot{H}$ 9·61=99·81; this is almost exactly the composition obtained for I. Scheerer adds that the so-called *brevicite* (Min., 327, anal. 14, 15, and 16) is nothing more than natrolite, which contains a considerable percentage of diaspore. For the further consideration of the disputed points upon the paramorphous nature of *Spreustein* (Paläo-Natrolith) see the original paper in Pogg. Ann., cviii, pp. 416—435.

NEPHELINE [p. 232, II].—P. v. Pusirewsky has analyzed the *elœolite* which is associated with cancrinite, zircon and other minerals in the Graphite-Mine at Mariinskaja in the Tunkinsk Mts. (Koksharow Mat. Min. Russlands, III, 78), and J. P. Kimball has described the same variety of nepheline, occurring with sodalite at Salem, Mass. (this Jour., [2], xxix, 65):

	Si	Al	Fe	Ca	Mg	Na	K	Ign.
1. Mariinskaja,	44·94	30·29	0·72	1·15	0·15	21·80	1·48	——=100·53 P.
2. Salem, G.=2·63.	44·31	32·80	*tr.*	0·40	——	16·43	5·50	1·47=100·91 K.

Nickel and Copper, arseniuret of.—This ore, mentioned by T. Sterry Hunt (this Jour., [2], xix, 417) as a mixture of *domeykite* and *copper-nickel*, has since been thoroughly examined by both Prof. Hunt (Rep. Geol. Survey, Canada, 1853–6, p. 388) and Prof. J. D. Whitney (this Jour., [2], xxviii, 15) giving analyses which confirm the above conclusion.

NICKEL-GYMNITE [p. 286, VII].—An ore, apparently an impure variety of this mineral, is described by T. Sterry Hunt (this Jour., [2], xix, 417, and Rep. Geol. Survey, Canada, 1853–6, p. 389), as occurring with the nickel ores of Michipicoten Island, Lake Superior.

OLIGOCLASE [p. 239, I].—Vom Rath has given analyses of *oligoclase* from the granite of Albulaberge, and also of a compact *lime oligoclase* from the diorite of Piz-Rosag, in Granbündten (Zeitschr. d. deutsch. geol. Gesell., ix, 226, 259):

	Si	Al	Fe	Ca	Mg	K	Na
Albulaberge, G.=2·725.	62·01	21·16	2·54	3·53	0·78	4·33	5·94=100·29
Piz-Rosag, G.=2·835.	57·64	22·99	3·92	8·09	0·37	1·79	5·25=100·05

The analyses were made on the ignited mineral. The specimen from Albulaberge lost 1·05 per cent, and that from Piz-Rosag 1·32 per cent on ignition.

The leek-green *feldspar* associated with pyrrhotine at Bodenmais (Bavaria) has been analyzed by Potyka (Pogg. Ann., cviii, 366). It is triclinic, and has the characteristic striæ on the cleavage surfaces. Sp. gr. 2·604. Composition:

Si	Al	Fe	Ca	Mg	K	Na
63·12	19·78	1·51	0·66	0·13	12·57	2·11 = 99·87

This gives an oxygen ratio of $\dot{R} : \dot{R} : Si$, of 1 : 2·86 : 10·17 or nearly 1 : 3 : 10,—a ratio intermediary between that of oligoclase and orthoclase; the sp. gr. (2·604) is also between that of oligoclase (2·56) and orthoclase (2·67).

ORTHOCLASE [p. 242, II, III, V—VII].—J. D. Whitney has analyzed the interesting crystallized *orthoclase* which is associated with native copper, calcite and the zeolites in many of the Lake Superior copper mines (this Jour., [2], xxviii, 16). It occurs in distinct crystals of a reddish flesh color, having a striking resemblance to stilbite. The crystals are rarely as much as one-tenth of an inch in length. Composition:

Si	Al	Fe	Mn	K	Na
65·45	18·26	0·57	*tr.*	15·21	0·65 = 100·14

OSERSKITE (*Breithaupt*), see *Aragonite*.

PECTOLITE [p. 305, II, III, VI, VII].—Analyses of three specimens of the very pure variety of this mineral from Bergen Hill, N. J., by J. D. Whitney (this Jour., [2], xxix, 205):

	Si	Ca	Mn	Fe	Na	H[a]
1.	54·82	33·12	0·66	2·6	8·78	2·36
2.	54·76	32·88	1·16		9·17	2·03
3.	54·27	32·83	1·24		8·94	2·72

(*a*) By the difference.

The direct determination of the water on the substance dried at 80° C. gave, for 2, 3·03, and for 3, 2·75 p. c. These results agree very closely with the previous analysis published by Prof. Whitney (Min., anal. 5). Specimen 3, from the Wheatley Collection in Union College, was considered the purest, and the analyses gives

the oxygen ratio for Ḣ, Ṅa, Ċa, S̈i as 1 : 1·05 : 3·83 : 11·84 or nearly 1 : 1 : 4 : 12, or the formula, as expressed by Prof. Whitney, Ṅa^{2}S̈i^4+4Ċa^{3}S̈i^2+3Ḣ=S̈i 54·22, Ċa 33·73, Ṅa 9·33, Ḣ 2·74. This corresponds much better with the results obtained than v. Kobell's formula, in which the oxygen ratio is 1 : 1 : 4 : 11.

Prof. Whitney calls attention to the relations of pectolite to spodumene, and also to wollastonite and pyroxene, the latter connection being more apparent when the formula is written (Ċa$\frac{4}{6}$, Ṅa$\frac{1}{6}$, Ḣ$\frac{1}{6}$)^{3}S̈i^2 or Ṙ^{3}S̈i^2.

Pennine [p. 295, II, V].—A new analysis of *pennine* from Zermatt by Victor Merz, gave (Kenngott's Uebersicht f. 1858, 68):

S̈i	Ä̇l	Ḟe	Ṁn	Ṁg	Ḣ
33·26	11·69	7·20	*tr.*	35·18	12·18 = 99·51

not differing materially from the previous results of Marignac, Schweizer and MacDonnel. For an extended discussion of the chemical composition of this mineral by Dr. Kenngott, see loc. cit., pp. 62—66.

Pholerite (p. 251].—F. A. Genth describes (this Jour., [2]. xxviii, 251) *pholerite* as occurring in the coal mines of Schuylkill Co., Pa., in yellowish white scales which become of a snow white color, and pearly lustre, on being treated with chlorhydric acid. Under the microscope the scales appear to be clinorhombic, having the planes i-i and -1-i. The specimens examined were from Tamaqua near Pottsville. Analysis No. 1, was made on the original mineral, in Nos. 2 and 3 the substance had been previously treated with chlorhydric acid. Nos. 1 and 2, were decomposed by fusion with carbonate of soda—No. 3 by treatment with sulphuric acid.

	S̈i	Ä̇l	Ḟe	Ċa	Ṅa	K̇	Ḣ
1.	46·93	37·90	0·18	0·93	*undetermined*		13·98 = 99·92
2.	46·98	39·65	—	—	0·11	0·06	13·69 = 100·49
3.	46·81	39·56	—	—	0·11	0·06	13·91 = 100·45

giving the formula Ä̇l^{3}S̈i^4+6Ḣ=S̈i 47·06, Ä̇l 39·20, Ḣ 14·71.

Phosphochalcite [p. 425, II, VI, VII].—Bergemann has found arsenic acid in all the native phosphates of copper.—Analysis of the *phosphochalcite* from Linz gave:

	Ċu	P̈	Ä̇s	Ḣ
Phosphochalcite,	69·97	19·89	1·78	8·21 = 99·85

(Abstract from Pogg. Ann., civ, 190, in Kopp's Jahresbericht, 1858, 726).

Pitchblende [p. 107, IV, V].—Hermann has given (Jour. f. prakt. Chem., lxxvi, 326) the name *uranoniobite* to the crystallized pitchblende from Strömsheien in Norway, previously described and analyzed by Scheerer (see Min., p. 108, anal. 5, under pitchblende). Scheerer remarks in his description (Pogg. Ann., lxxii, 568) that it is possible that the metallic acids found in the analysis may be due to admixture with a substance he calls *Niob-pelopsaures Uran-Manganoxydul* (columbate of uranium and manganese) with which the pitchblende is associated;—further investigation is needed to establish its claims to be considered a distinct species.

Hermann also gives a new analysis of the *pitchblende* from Joachimsthal:

	PbS	S̈i	Ä̇l	Ḟe	B̈i	C̈	Ü	Ṗb	Ṁn	Ċa	Ṁg	Ḣ
G.=6·97.	2·84	2·45	0·33	1·88	1·23	52·37	28·84	0·74	0·14	5·78	0·41	2·59

with traces of arsenic. In the same paper Hermann communicates an analysis of the so-called *pittinite* (Pittinerz, Breithaupt) from Joachimsthal. The mineral occurs in amorphous opaque masses of a pitch-black color. It has an uneven and slightly conchoidal fracture, and a highly resinous lustre. Streak greenish-brown. H.=4. Sp. gr. 5·16. Heated in tube yields water containing traces of fluorine and ammonia; fused with soda on charcoal gives a globule containing lead and bismuth. Easily decomposed by nitric acid with separation of gelatinous silica on evaporation. Composition:

S̈i	C̈	Ḟe	B̈i	Ṗb	Ċa	Ṁg	Ḣ	Insol.
5·00	68·45	4·54	2·67	2·51	2·26	0·55	10·06	3·20 = 99·23

with traces of fluorine, ammonia, phosphoric and carbonic acids. [This substance is evidently very nearly related to pitchblende, and is probably a result of the alteration of that mineral. Hermann endeavors to show that silica is an essential constituent of pitchblende and allied uranium minerals, but as most of these substances are amorphous, and as their composition varies considerably, it seems possible that the silica may be due to admixture with some earthy silicate.—G. J. B.]

PITTINITE.—See *Pitchblende*.

PLATINUM [p. 12, I—IV].—Analyses of platinum from various localities, by H. St.Claire Deville and H. Debray (Ann. de Chimie, [3], lvi, 449):

	Pt	Ir	Rh	Pd	Au	Cu	Fe	X[a]	Sand	Pb(?)	Os & loss	
1.	86·20	0·85	1·40	0·50	1·00	0·60	7·80	0·95	0·95	—	——	=100·25
2.	80·00	1·55	2·50	1·00	1·50	0·65	7·20	1·40	4·35	—	——	=100·15
3.	76·82	1·18	1·22	1·14	1·22	0·88	7·43	7·98	2·41	—	——	=100·28
4.	85·50	1·05	1·00	0·60	0·80	1·40	6·75	1·10	2·95	—	——	=101·15
5.	79·85	4·20	0·65	1·95	0·55	0·75	4·45	4·95	2·60	—	0·05	=100·00
6.	76·50	0·85	1·95	1·30	1·20	1·25	6·10	7·55	1·50	0·55	1·25	=100·00
7.	51·45	0·40	0·65	0·15	0·85	2·15	4·30	37·30	3·00	—	——	=100·25
8.	45·70	0·95	2·65	0·85	3·15	1·05	6·80	2·85	35·95	—	0·05	=100·00
9.	59·80	2·20	1·50	1·50	2·40	1·10	4·30	25·00	1·20	—	0·80	=100·00
10.	61·40	1·10	1·85	1·80	1·20	1·10	4·55	26·00	1·20	—	——	=100·20
11.	77·50	1·45	2·80	0·85	*undet.*	2·15	9·60	2·35	1·00	—	2·30	=100·60
12.	76·40	4·30	0·30	1·40	0·40	4·10	11·70	0·50	1·40	—	——	=100·50

(a.) Iridosmine.

Nos. 1, 2, and 3 from Choco (Columbia), South America; 4, 5, and 6 from California; 7, Oregon; 8, Spain; 9, 10, Australia; 11, 12, Russia.

For analyses of platinum ore from Goenoeng Lawack in Borneo by Prof. Bleekrode see Pogg. Ann., cvii, 189.

PYRITES [p. 54, I, IV].—G. Rose has described a pseudomorph of *pyrites* after *pyrrhotine*, the crystals are six-sided prisms, two inches across and one inch in thickness (Zeitschrift d. deutsch. geolog. Gesellschaft, x, 98).

PYROMORPHITE [p. 400, II, IV].—Analyses of Russian *pyromorphite* by Struve (Kokscharow, Mat. zur Min. Russlands, iii, 42):

		PbCl	Ṗb	F̈e, C̈r	Ẍs	V̈	P̈	
1. Beresowsk,	G.=6·715.	9·94	73·36	0·59	—·	*tr.*	15·82	=99·71
2. Altai (Tomsk),	G.=5·537.	10·13	73·40	—	2·61	—	12·90	=99·04

PYROXENE [p. 158, I, II, V—VIII].—Reuss has described a compact white *pyroxene* from Oberrochlitz in Bohemia. Under the microscope it shows a crystalline structure. The mineral is snow white when pure, but sometimes has a light green color from admixture with chrysocolla, malachite and allophane. H.=5·5—6. G.=3·398. Decomposed by chlorhydric acid with gelatinization. Analysis by v. Payr (Wien Akad. Ber., xxv, 557):

S̈i	C̈a	M̈g	F̈e	M̈n	
55·03	20·72	15·71	4·84	3·16	=99·46

PYRRHOTINE [p. 50, I, II].—Analysis of *pyrrhotine* from Bernkastel on the Moselle by Baumert gave Fe 61·0, S 39·4, and no nickel (Verhandl. d. naturhist. Ver. d. Rheinlande u. Westphalens, xiv, s. lxxxv). For observations on nickeliferous pyrrhotine from Snarum see Müller in B. u. H. Zeitung, xvii, 304.

QUARTZ [p. 145, II—IV, VII].—Blum and Carius have described *quartz* as pseudomorph of *celestine*, from Girgenti. The crystals contained S̈i 98·80, S̈rS̄ 1·78 (Pogg. Ann., ciii, 628, in Kopp's Jahresbericht, 1858, 745).

REALGAR [p. 31, VI].—Analysis of *realgar* from Pola de Lena in Asturia, Spain, by Dr. Hugo Müller (Quar. Jour. Chem. Soc., xi, 242) gave S 30·00, As 70·25.

RIPIDOLITE [p. 296, I, V].—An interesting and peculiar variety of this mineral from Steele's Mine, Montgomery Co., North Carolina, has been described by Dr. F. A. Genth in this Journal, [2], xxviii, 250. Composition:

$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	Fe	$\dot{M}n$	$\dot{M}g$	$\dot{H}$
24·90	21·77	4·60	24·21	1·15	12·78	10·59

SAPONITE (Nicklès).—For a more extended description of this silicate noticed in the Suppl. VII, see Ann. de Chimie, [3], lvi, 46.

Saualpite.—A synonym for a variety of zoisite from the Saualp in Carinthia.

SCHEELITE [p. 347].—F. A. Genth has found *scheelite* at the Bangle Mine in Cabarras Co., and also at Flowe mine, Mecklenburgh Co., North Carolina. At the former place it occurs in granular masses three-fourths of an inch in diameter; it has a pale yellowish-brown color, and a distinct octahedral cleavage. Composition (this Jour., [2], xxviii, 252):

$\ddot{W}$	$\ddot{S}n$	$\dot{C}u$	$\dot{F}e$	$\dot{C}a$	
79·52	0·13	0·08	0·18	19·31	= 99·22

The variety from Flowe mine was observed in crystals, in one case a modification of the octahedron 1, truncated by 1-*i*,—crystal about three-tenths of an inch in length; another specimen, half this size, had an orange color and was a combination of the planes $\frac{1}{2}$ and *i*-*i*.

Another variety from Flowe mine, forming what Dr. Genth calls *rhombic tungstate of lime*, occurs in small indistinct crystals—the largest one-quarter of an inch long. Each crystal has a nucleus of wolfram, and the following planes are given: *I*, *i*-$\frac{1}{3}$, $\frac{1}{2}$-$\frac{1}{3}$, 1, and 1-$\frac{1}{3}$; cleavage could not be observed. Dr. Genth does not believe these crystals to be pseudomorphs, and suggests that tungstate of lime is dimorphous,—a conclusion which, though extremely interesting, we hesitate to accept until the subject has been more fully investigated.

SERPENTINE.—Observations on the crystalline structure of serpentine by Websky in Zeit. d. deutschen geol. Gesellsch., x, 277.

SMITHSONITE [p. 447, I, III, VII].—For analyses of zinc ores from Arkansas by Dr. Elderhorst see First Geological Report of Arkansas, pp. 147–155.

SODALITE [p. 229, II, VI].—J. P. Kimball has published a description and analysis of sodalite, from an erratic block of compact syenite at Salem, Mass. (this Jour., [2], xxix, 67). The mineral was associated with elæolite, orthoclase, biotite, zircon, and albite (?) Occurs in crystalline, sub-translucent masses; cleavage indistinct; lustre greasy; color lavender-blue. Sp. gr. on three specimens 2·294, 2·303, 2·314. Chemical composition:

$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	$\dot{N}a$	Cl	
37·33	32·70	*tr.*	24·31	6·99	= 101·33

Calculating the chlorine to exist as chlorid of sodium we have:

$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	$\dot{N}a$	Na	Cl	
37·33	32·70	*tr.*	18·17	4·57	6·99	= 99·76

corresponding very closely to the analyses of the sodalite from Litchfield in Maine by Whitney (Min., anal. 5, 6). Dr. Kimball remarks that the sodalite from both Litchfield and Salem, is found in erratic blocks, but the absence of cancrinite as an associating mineral in the Salem specimens, would seem to favor their being derived from different sources.

STROYMEYERITE [p. 48].—Prof. W. J. Taylor has described and analyzed a variety of *stroymeyerite* occurring at Copiapo in Chile (Proc. Acad. Nat. Sci. Phila., Nov. 1859). It is found in small six-sided trimetric crystals not larger than one-eighth of an inch in diameter. Its hardness is 2·5—3. Lustre metallic; color dark steel-gray; streak nearly black and shining. Sectile, crystals brittle. It occurs in barytes in small cavities associated with quartz crystals, and upon the latter are implanted the crystals of stroymeyrite, together with small crystals of pyrargyrite. Analysis gave:

S	Ag	Cu	Fe		
16·35	69·59	11·12	2·86	=	99·92

This composition differs materially from the published analyses of stroymeyerite, although not more than the analyses of specimens from different localities vary

from each other. Cu and Ag appear to replace each other in this mineral in all proportions. The formula is (Cu, Ag, Fe)S.

TALKOID, *Naumann* (Mineralogie, 5te, Aufl. 255).—The sparry crystalline talc from Presnitz described by Scheerer (Pogg. Ann., lxxiv, 321, this Jour., [2], xiv, 39) has been named *talkoid* by Naumann. It is snow white and broadly foliated occurs with magnetite at Presnitz. Sp. gr. 2·48. Composition, according to Scheerer and Richter:

	$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{H}$	
1.	58·46	0·09	1·09	—	0·61	32·83	6·56	= 99·64
2.	58·70	0·06	1·01	0·39	0·81	32·07	6·56	= 99·50

for which Naumann gives the formula $\dot{M}g^3\dot{S}i^5+\dot{H}$.

TANTALITE [p. 351, III—VI].—A. E. Nordenskiöld has analyzed tantalite from a new locality at Björtboda in Finland (Pogg. Ann., cvii, 374):

$\dot{T}a$	$\dot{S}n$	$\dot{F}e$	$\dot{M}n$		
83·79	1·78	13·42	1·63	=	100·62

the oxygen ratio between the bases and the metallic acids is 1 : 4·83, most nearly resembling the composition of the Tammela tantalite.

TENNANTITE [p. 84, II].—Vom Rath has published the following analyses of tennantite from Cornwall (Verhandl. d. naturhist. Ver. d. Rheinlande u. Westphalens, xv, s. lxxii, in Kopp's Jahresbericht f. 1858, 680):

	Denisity.	S	Cu	Fe	Zn	As	
1*a*.	4·652.	25·22	46·88	6·40	1·33	18·72	= 98·55
1*b*.	——	27·13	44·43	6·88	1·43	20·13	= 100·00
2.	4·69.	26·34	52·97	2·82	—	18·06	= 100·19

No. 1*a* is the direct result of the analysis—the mineral was associated with black oxyd of copper, and assuming the amount of this substance to be seven per cent, and averaging the analysis to one hundred, gives the result as in No. 1*b*. Analysis No. 2 was by Baumert. According to v. Rath, the ratio between the metallic sulphids and the sulphid of arsenic in tennantite is 5 : 4, while the analogous ratio in tetrahedrite is 4 : 3.

TOURMALINE [p. 270, II, IV, VII].—Jenzsch (Pogg. Ann., cviii, 648) has examined a crystal of *tourmaline* from Elba which he considers to be optically bi-axial. He suggests, from his investigations, that although the tourmaline crystals from Elba and Penig (Saxony) approach very nearly the hexagonal form, that they belong either to the trimetric or monoclinic system—a view previously suggested by Breithaupt's measurements. Breithaupt publishes a preliminary notice in the Berg und Hüttenmannische Zeitung, xix, 93, of a forthcoming monograph on this subject.

TRIPHYLINE [p. 406, 513].—F. Oesten obtained from the analysis of a very pure specimen of triphyline from Bodenmais in Bavaria (Pogg. Ann., cvii, 438):

	$\dot{P}$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{L}i$	$\dot{K}$	$\dot{N}a$	$\dot{S}i$	
G.=3·545—3·561.	44·19	38·21	5·63	0·76	2·39	7·69	0·04	0·74	0·40	=100·05

This gives the oxygen ratio between the bases and phosphoric acid 15·34 : 24·77 = 3·09 : 5, and the formula, $\dot{R}^3\dot{P}$, the same as first proposed by Fuchs. Wittstein, in a recent note (Pogg. Ann., cvii, 511), calls attention to the fact that eight years since he published results giving the above formula, and says moreover, that a portion of the iron exists as sesquioxyd. Oesten has since (Pogg. Ann., cviii, 648) published proof that the specimen he examined was entirely unaltered, and that all the iron existed as protoxyd.

TYRITE (?) [I, III, IV].—Potyka (Pogg. Ann., cvii, 590) has analyzed specimens of supposed tyrite from Norway which prove to be a new columbate containing several per cent of potash, and distinct from the tyrite of Forbes. The chemical composition was found to be:

$\dot{C}b$	$\dot{Z}r$	$\dot{W}$	$\dot{S}n$	$\dot{P}b$	$\dot{C}u$	$\dot{Y}$	$\dot{C}e$	$\dot{F}e$	$\dot{U}$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$	$\dot{H}$	
43·49	0·80	1·35	0·09	0·41	0·35	31·90	3·68	1·12	4·12	1·95	*tr.*	7·23	3·71	=100·20

The ratio between the metallic acids and bases, exclusive of the water is, as 1 : 1·04 or $\dot{R}^3\ddot{C}b$. The mineral occurs implanted in red feldspar in small irregular masses having an uneven fracture, but no distinct cleavage. Lustre, sub-metallic; color black, in thin splinters reddish-brown and translucent on the edges; streak reddish-brown; hardness that of apatite (5). Sp. gr. in coarse powder =5·124 (16·6° C.). When hot water is poured upon fragments a crepitation or crackling takes place. B.B. with borax gives a reddish-yellow bead while hot, which on cooling becomes yellow; with salt of phosphorus is completely dissolved to a greenish-yellow bead while hot, becoming green on cooling. No reaction for manganese with soda. Treatment with concentrated sulphuric acid gave no reaction for fluorine. [This mineral corresponds in many of its physical and blowpipe characters with the *bragite* of Forbes (see Suppl. III). Possibly a thorough analysis of authentic specimens of bragite would show them to be very nearly related, if not identical. —G. J. B.]

Uranium, silicates of, see Hermann's paper in Jour. f. prakt. Chem., lxxvi, 320.

URANONIOBITE (*Hermann*), see *Pitchblende*.

URANOCHALCITE, *Hermann.*—This name has been given by Hermann to a mineral from Joachimsthal (Jour. f. prakt. Chem., lxxvi, 321). It occurs in reniform amorphous masses having a metallic appearance. Fracture compact, and slightly conchoidal, with a feeble metallic lustre; brittle; opaque; color between steel-gray and pinchbeck-brown; streak black. H.=4. Sp. gr. 5.04. Heated in a closed tube the mineral at first gives off water, and then a sublimate of realgar, and finally metallic arsenic, leaving a black residue consisting chiefly of bismuth, uranium, copper, and iron. Treated with nitric acid the mineral is dissolved with separation of sulphur. On evaporation of the solution, silica separates in the gelatinous form. The analysis gave:

S	As	Cu	Ni	Fe	$\dot{S}i$	$\dot{B}i$	$\ddot{C}$	$\dot{F}e$	$\dot{U}$	$\dot{H}$	Ag
5·79	7·23	10·21	0·97	2·31	4·40	36·06	14·41	11·95	3·27	2·40	*tr.*=99·00*

Hermann writes the formula $5(\dot{R}^4\dot{S}i+4\dot{R}\dot{S}i+10\dot{H})+R(AsS)$. [It is quite improbable that this composition is that of a simple mineral, and until further investigation we may reasonably doubt the homogeneousness of the substance analyzed.—G. J. B.]

VANADINITE [p. 362, II—IV].—Kokscharow considers the *vanadinite* crystals from Beresowsk to be pseudomorphs of *pyromorphite*. Struve found in the interior of each vanadinite crystal a portion of unaltered pyromorphite. The mean of two analyses gave:

	PbCl	$\dot{P}b$	$\dot{F}e\ddot{C}r$	$\ddot{V}$	$\dot{P}$
G.=6·863.	9·60	71·13	0·43	15·92	2·92

Struve represents this composition by the formula $PbCl+\dot{P}b(\dot{P}_{\frac{1}{3}}, \ddot{V}2_{\frac{1}{3}})$ or $(3\dot{P}b^3\dot{P}+PbCl)+5(3\dot{P}b^3\ddot{V}+PbCl)$.—(Kokscharow, Mat. Min. Russlands, iii, 44).

VIVIANITE [p. 415, III, IV].—For an article on the composition and formation of *vivianite* by Alphonse Gages, see L., E. and D. Phil. Mag., [4], xviii, 182.

WATER [p. 110].—Analysis of water from the Dead Sea, by Dr. F. A. Genth.—Ann. d. Chem. u. Pharm., cx, 240.

WOLFRAM [p. 351, I—IV].—F. A. Genth has published (this Jour., [2], xxviii, 253) an analysis of the wolfram which forms the nucleus of the peculiar tungstate of lime crystals alluded to under scheelite. One crystal showed the planes *I*, *i*-$\bar{i}$, $\frac{1}{2}$-$\bar{i}$, and 1-$\bar{i}$. Sp. gr. 7·496 (at 25° C.). Composition:

$\ddot{W}$	$\dot{S}n$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	
75·79	*tr.*	19·80	5·35	0·32	= 101·26

corresponding to variety II. (Min., p. 352), having the formula $4\dot{F}e\ddot{W}+\dot{M}n\ddot{W}$.

* The original gives 100, but owing to a typographical, or other error the analysis adds up only 99.

WULFENITE [p. 349, II, V].—The massive wulfenite from Garmisch, is a mixture of molybdate of lead, with carbonate of lead and other substances, as shown by Wittstein's analysis (Kopp's Jahresbericht, 1858, 721):

Ṗb	C̈a	M̈g	F̈e	M̈o	S̈i	P̈	Loss (C̄ & trace V̈)
33·80	10·85	3·57	2·80	20·00	16·20	0·04	12·74

ZINC-BLOOM [p. 460, 513, VII].—Dr. Elderhorst has described a hydrous carbonate of zinc from Marion County, Arkansas, as a new species under the name *marionite* (First Geol. Rep. Arkansas, p. 153). The chemical composition he found:

Żn	C̄	Ḧ	
73·26	15·01	11·81	= 100·08

[This is identical with analyses 1*a*, of zinc-bloom from Santander in Spain, by Peterson and Voit, published in the last supplement. This analysis gave Żn 73·1, C̄ 15·1, Ḧ 11·8. These analysts found that zinc-bloom undergoes a change on exposure to the air, thereby losing both carbonic acid and water. A specimen of 1*a*, exposed to the air for three months was found to contain Żn 74·73, C̄ 13·81, Ḧ 11·45. Other analyses by Braun are quoted in the last supplement. Peterson and Voit (Ann. d. Chem. u. Pharm., cviii, 50) give the formula for zinc-bloom $\dot{Z}n_3\bar{C}_2\dot{H}_6$, which is the same as that given by Dr. Elderhorst for *marionite*;—it is an interesting fact that this is also the composition of the precipitate, produced by adding an equivalent of carbonate of soda to a zinc salt at the boiling temperature. Marionite may be considered as zinc-bloom, and the earlier analyses of this species by Smithson and Berthier, are undoubtedly less correct than those of Karsten and the more recent ones by Peterson, Voit, Braun, and Elderhorst.—G. J. B.]

Terreil mentions the occurrence of zinc-bloom at Santander in oolitic grains (L'Institut, No. 1347).

ART. XXXIV.—*Theoretical Determination of the Dimensions of Donati's Comet;* by Prof. W. A. NORTON.

IT is proposed in the present article to investigate the dimensions of the great comet of 1858, at certain specified dates, upon the theory developed in this Journal, (vol. xxvi; No 79), and compare the theoretical determinations with the results of observation. Resuming the equation of the approximate orbit of a particle emitted from the nucleus, obtained in the investigation alluded to, viz.

$$\frac{\sqrt{2pr}}{k\sin a}\left(1-\sqrt{1-\frac{k\sin a}{pr}z}\right)=\sqrt{\frac{2x}{k\cos a}}. \quad . \quad . \quad . \quad (1.)$$

in which the axis of z coincides with the original direction of motion, a denotes the angle of inclination of this initial line of direction to a line perpendicular to the radius-vector, r the radius of the nucleus, p the acceleration due to the repulsive force of the nucleus at its surface, and k the opposite acceleration produced by the sun's repulsion; let us pass to a new system of rectangular axes, x' and z', of which the axis of z' is coincident with the radius-vector of the orbit of the comet. Effecting the transformation of coördinates, reducing, and denot-

ing by H the distance of the vertex of the cometary envelope from the nucleus $\left(=\frac{p\,r}{k}\right)$, we have

$$x'^2 - 2H\sin 2a\,.\,x' = -2H\sin 2a\cot a\,.\,z'. \quad . \quad . \quad . \quad . \quad (2.)$$

Putting $H\sin 2a = K$,

$$x'^2 - 2Kx' = -2K\cot a\,.\,z'. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3.)$$

Let $z'=0$, and we obtain for the half-breadth of the envelope, $\frac{b}{2}=2K$; and thence, for the coördinates of the vertex of the curve described by the particle, $X'=\frac{b}{4}=K$, and $Z'=h=\frac{K}{2}.\tan a$. Transferring the coördinates to this point, we get for the equation of the curve, referred to its vertex,

$$x''^2 = 2K\cot a\,.\,z''. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4).$$

This is the equation of a parabola, of which the parameter, $2p_1 = 2K\cot a = 4h\cot^2 a$; and the distance from the focus to the vertex $=\frac{K}{2}\cot a = h\cot^2 a$.

It is also the equation of the curve that would be described by a particle if it were projected from the nucleus with a certain velocity, and subsequently repelled by the sun alone. From which it appears that the path pursued by a particle repelled from the nucleus is very nearly the same, and, for the purposes of the present investigation, may be regarded as the same, as that which would be followed if the particle were simply projected from the nucleus. If we had occasion to trace accurately the trajectory of the particle in the vicinity of the nucleus, another investigation would become necessary. It should also be observed, that in the case of any particle, which, on its return from its excursion toward the sun, comes into proximity to the nucleus, the parabolic projectory becomes materially modified by its repulsive action, and equations (3 and (4) are inapplicable.

We may conclude from the result just obtained that, so far as the form and dimensions of the nebulous envelope are concerned, the theory of a repulsion exerted by the mass of the nucleus does not differ materially from that of the projection of the cometary matter by an instantaneous force from its surface; which, it appears, has been advocated and discussed by Bessel.

Other determinations relative to the envelope of the comet may be effected by the following formulas; in which Z = the greatest distance attained by a particle, in the initial direction of motion; Y = the actual distance from the nucleus, of the particle when in this extreme position; φ = the angle included between Z and Y; β = the inclination of the tangent drawn to

any point of the curve followed by the particle, to the radius-vector of the orbit of the comet; v = the velocity of the particle at the vertex of its parabolic path; and v' = its velocity at any other point of the curve;

$$H=\frac{pr}{k}. \qquad Z=\frac{H}{\sin a}. \qquad Y=\frac{H}{\sin^2 a}. \quad . \quad . \quad . \quad . \quad (5.)$$

$$\varrho=\text{co.}\,a. \qquad \tan\beta=\sqrt{\frac{H\sin 2a\cot a}{2z''}}=\sqrt{\frac{p_1}{2z''}}. \quad . \quad . \quad . \quad (6.)$$

$$v=\sqrt{kp_1}. \quad . \quad . \quad (7.) \qquad v'=\frac{v}{\sin\beta}. \quad . \quad . \quad . \quad . \quad (8.)$$

$$v'=\sqrt{k(p_1+2z'')}=\sqrt{k\left(p_1+\frac{x''^2}{p_1}\right)}. \quad . \quad . \quad . \quad (9.)$$

More accurately, we may obtain the velocity v'' at right angles to the radius-vector, for any point of the actual curve, from the following equation:

$$v''=\cos a\sqrt{2pr\left(1-\frac{r\cos a}{x'}\right)}. \quad . \quad . \quad . \quad . \quad (9^a.)$$

in which x' = distance of the point from the radius-vector. The distance from the nucleus to any point of the trajectory of the particle, whose coördinates are known, may be readily obtained from the polar equation of the curve.

Equs. (1) to (9^a) have been obtained on the supposition that the nucleus is at rest; or, in other words, they refer to the relative motion of the cometary particle and nucleus, on the supposition that the two have the same velocity, and a constant direction of motion through space. Strictly speaking, there is not a perfect accordance between the two motions, even during the short interval of time that the particle remains within the limits of the envelope; but no material modifications of the theoretical results are required on this account, in investigating the form and dimensions of the envelope. But when we undertake to follow the cometary particle, after it has left the region of the envelope, and is receding from both the nucleus and the sun, under the influence of the solar repulsion, it will no longer answer to neglect the orbitual motion of the nucleus.

The general problem, to find the relative positions of a repelled cometary particle, and the nucleus of a comet, after any interval of time, appears to have been first effectually solved by Bessel. This important problem has recently been taken up independently, and solved anew by Prof. Peirce; who has shown that the orbit of the repelled particle is a hyperbola convex towards the sun, and has verified the supposed law of variation of the sun's force of repulsion. In pursuing the line of investiga-

tion in hand, we are led to take a point of view somewhat different from that occupied by either of these eminent astronomers. It is now proposed to determine both the true and apparent positions of the receding particle, after the lapse of any interval of time, directly from the initial velocity and direction of motion; in order to take account of the various circumstances of the original motion of the different particles supposed to proceed from the nucleus. The following formulas will serve for this purpose. Equs. (12) to (15) have been deduced from the general equations of motion of a body around a centre of attraction, by changing the sign of the force, and adapting them to convenient computation. Equ. (17) for calculating the true anomaly of the particle in its hyperbolic orbit, from the time, was independently investigated. It is sufficiently accurate for our purpose, and the calculation can be more readily effected with it than by the intervention of the eccentric anomaly. The constants which enter into the equation can be determined by very simple formulas, for any comet the elements of whose orbit are known, and for any position of the comet in its orbit; their values having been determined by other means for the perihelion of any one comet. They depend upon the initial circumstances of motion of the particle emitted from the nucleus. Equ. (16) was deduced from equ. (17).

If any particle, on leaving the sphere of influence of the nucleus, is subject to a diminished attraction from the sun, it will describe a hyperbola concave toward the centre of attraction, and will recede from the nucleus, though less rapidly than if it were effectively repelled by the sun. Equs. (22) to (25) serve for this case. There will be occasion to make use of them when we shall undertake to determine all possible particles that at any assumed date may go to make up the concave outline of the tail.

New Haven, March 28th, 1860.

(*To be continued.*)

ART. XXXV.—*The Great Auroral Exhibition of Aug. 28th to Sept. 4th*, 1859.—4TH ARTICLE.

IN the three preceding numbers of this Journal we have given observations of the Aurora of Aug. 28th to Sept. 4th, from almost every part of North America between the parallels of 13° and 48° north latitude. We now present a summary of observations of the same aurora in Europe, with some reports from Asia, and accounts of a simultaneous auroral exhibition in the southern hemisphere.

1. *Observations at Christiania, Norway,* (lat. 59° 54′), *by* Prof. CHRISTOPH HANSTEEN.

1859, Aug. 28th. At 10 P. M. only an indistinct coruscation behind the clouds in the north.

Aug. 29th, $12^h\ 10^m$ A. M. perfectly bright, almost as at full moon; the air dim with cirro-stratus, nevertheless the aurora shone through everywhere with strong radiating and flaming motion, very irregularly and unsteady. Corona was often formed; best formed at $12^h\ 17{\cdot}5^m$. Altitude 71° 37′ from south, azimuth 9° 57′ east. At $12^h\ 18{\cdot}5^m$ a purple-colored beam shot in east to γ Andromedæ. At $12^h\ 21{\cdot}5^m$ altitude of corona 72° 27′; azimuth 14° 55′ east. At no time were there regular bows. There was always a vacant space over the south horizon, but often of a suspicious character. It continued after 1 A. M. without essential variation in strength or character.

Aug. 29th, evening, rain—heavens covered.

Aug. 30th, " " " "

Aug. 31st, $11\frac{1}{2}$ P. M., lightning and thunder in southwest.

Sept. 1st, heavy rain—thunder.

Sept. 2d, radiating and strong flaming aurora, $12\frac{1}{2}^h$.

Sept. 3d, radiating aurora over the whole northern heavens to a little south of zenith; rather dimly. It continued to illuminate the heaven after it was almost covered. At $1\frac{3}{4}^h$ A. M. very clear behind the skies everywhere.

Sept. 4th, 10 P. M., radiating aurora in the north to 30° altitude. Later in the night, vehemently flaming with broad flames.

Sept. 5th, 10 P. M., elegant radiating aurora which dilated from the whole northern horizon to south of zenith, mostly behind a veil of cirro-stratus. At an altitude of 45° it was partly flaming. At 12^h it had nearly ceased.

Sept. 6th, at 10 P. M., an arc from 6° to 8° broad, the lower edge of which had an altitude of 5°.

The following table shows the state of the Bifilar magnetometer between Aug. 28th and Sept. 6th:—

1859.	Hour.	Bifilar.	1859.	Hour.	Bifilar.	1859.	Hour.	Bifilar.
	h m			h m			h m	
Aug. 28	9 23 A. M.	704·09	Aug. 30	9 15 A. M.	670·10	Sept. 2	4 27 P. M.	1438·91
" "	2 10 P. M.	764·98	" "	1 55 P. M.	751·18	" "	5 30 "	1104·69
" 29	9 28 A. M.	243·0	" "	5 30 "	732·08	" "	6 30 "	1020·41
" "	9 43 "	349·3	" 31	9 16 A. M.	667·72	" 3	9 21 A. M.	650·12
" "	10 9 "	638·78	" "	1 55 P. M.	737·95	" "	1 58 P. M.	926·13
" "	10 15 "	531·81	Sept. 1	9 21 A. M.	678·02	" 4	9 19 A. M.	670·05
" "	10 27 "	709·11	" "	2 5 P. M.	711·26	" "	4 28 P. M.	1034·2
" "	10 30 "	670·18	" 2	9 21 A. M.	609·70	" "	4 45 "	959
" "	10 33 "	723·43	" "	9 49 "	780·07	" 5	9 14 A. M.	705·15
" "	1 55 P. M.	941·50	" "	11 29 "	616·87	" "	9 15 P. M.	1060·49
" "	5 35 "	801·42	" "	2 25 "	1381·77	" 6	9 11 A. M.	641·85

The greatest difference observed during this period was 1195·91 parts of the scale. One division of the scale corresponds to $\frac{1}{1\,5\,9\,7\,8}$ of the horizontal intensity. Hence the variation of the horizontal intensity from Aug. 29 to Sept. 2 amounted to nearly $\frac{1}{1\,3}$ of its whole value.

The inclination of the magnetic needle was observed as follows:

Aug. 29th,	10h	21m	A. M.	71°	31′·5	Sept. 2d, 10h 23m A. M. 71° 29′·0	
	5	23	P. M.	71	19·8	4 16 P. M. 70 26·9	
						6 26 P. M. 71 5·8	

The mean inclination of the needle in 1859 was 71° 18′.

The effect of this aurora upon the telegraph lines in Norway was much greater than in France and Germany. The effect was noticed from the opening of the stations at 7 A. M. On the 29th communication was interrupted till 11 A. M. on almost all the lines; and likewise Sept. 2d, but with a long repetition after 2 P. M. Sept. 3d, only towards 8½ A. M. During the remaining parts of those days, the perturbations were more or less uninterrupted, nevertheless communication could be maintained in some degree. Strong currents caused simultaneous attractions of all the armatures. The galvanometer showed strong deviations, sometimes with slow, sometimes with sudden movements, from one side to the opposite.

The intensity of the currents was greatest upon the longest lines going towards the north, on which sparks and uninterrupted discharges were from time to time observed. Pieces of paper were set on fire by the sparks of these discharges. In Bergen, where the line to Stavanger runs in a north and south direction, the current was at times so strong, especially Sept. 2d and 3d, that it was necessary to connect the lines with the earth in order to save the apparatus from destruction. The phenomena appeared less strong in Christiansand, in the southern part of Norway, where the lines run east and west.

2. *Observations made in different parts of England; extracted from the London Times.*

A. Durham (lat. 54° 46′).

Sept. 1, aurora; Sept. 2, vivid white aurora; Sept. 3, aurora. Sept. 4, faint aurora.

B. Preston (lat. 53° 45′), by R. C.

Sept. 2d, there was a brilliant auroral display, continuing from 11 to 12 o'clock, and a second appearance, though not so brilliant, at a little before 2 o'clock on the morning of Sept. 3d. During the first display, the whole of the northern hemisphere was as light as though the sun had set an hour before, and luminous waves rolled up in quick succession as far as the zenith, some of a brilliancy sufficient to cast a perceptible shadow on

the ground. To the northwest there was a large patch of light of a deep crimson hue, while the waves of light were white, as also were the streamers which occasionally shot across the northern part of the sky. It was the most brilliant aurora that has been witnessed here for many years.

C. Nottingham (lat. 52° 57′), by E. J. Lowe.

On the evening of Aug. 28th and morning of Aug. 29th there was an unusually brilliant auroral display. From $8^h\ 40^m$ P. M. until 9 P. M. Aug. 28th, curtains of red light were visible near the zenith. By $11^h\ 40^m$ P. M. the glare of orange light in the north was powerful enough (even through much cloud) to make the hands of a watch visible. At $12^h\ 25^m$ A. M. the light was so strong that it gave the impression of daylight. At $12^h\ 45^m$ an opening in the clouds near the zenith disclosed the cupola which was situated exactly on Alpha Andromedæ. At $1^h\ 15^m$ A. M. magnificent rays of light met two degrees east of Alpha Andromedæ. At this time three-fourths of the sky was covered with aurora. At $2^h\ 30^m$, there being more clear sky, a splendid mass of aurora was visible, forming an ever changing cupola close to Gamma Trianguli. All the coruscations moved slowly eastward. At $3^h\ 15^m$ the cupola was formed near Gamma Andromedæ.

Sept. 3, strong aurora near the horizon.

Sept. 4, aurora.

D. Grantham (lat. 52° 55′).

Aurora Aug. 28th, 29th, 30th, 31st, and Sept. 3d.

E. London (lat. 51° 37′).

Aug. 28th, at $11^h\ 30^m$ P. M., auroral light in the north. At $0^h\ 15^m$ A. M. Aug. 29th it assumed the form of a luminous arch, similar to daybreak, and in the southwest there was an intense glare of red covering a very large extent; at $0^h\ 20^m$ streamers; at $0^h\ 25^m$ the streamers rose to the zenith and were tinged with crimson at their summits; at $0^h\ 45^m$ frequent coruscations; at $1^h\ 0^m$ the arch which had partially faded was re-formed, the body of light being very strong, but not sufficient to enable one to read any but very large print; at $1^h\ 30^m$ light equally strong, but outline indistinct; at 2 A. M. much less light and very indistinct. Continued till $2^h\ 30^m$ A. M.

Sept. 3, aurora.

F. Clifton (lat. 51° 27′), by William C. Burder.

Aug. 28th, about $10^h\ 45^m$ P. M., commenced a brilliant auroral display. At first there were several fine streamers, some of them white, and some faint crimson, extending from near the horizon almost vertically to α and β Ursæ Majoris. From that time till midnight there were generally very beautiful streamers, but without lateral motion, most of them being not quite vertical, but inclining slightly towards the east at the top. There was

also always a general light, extending at midnight from northeast to west, and sometimes bright enough to enable a person to read the time on the face of an ordinary watch.

The aurora was repeated Sept. 1st, Sept. 2d, and Sept. 3d.

G. Aldershot (lat. 51° 15′).

Magnificent display of aurora Aug. 28th, and till early morning Aug. 29.

H. Brighton (lat. 50° 50′).

Aug. 29th, about half past one o'clock, a fine aurora occupied more than one-half the sky. It had the appearance of an irregular hemisphere of white light fringed with a band of crimson from twenty to thirty degrees broad, stretching from southwest to northeast by east.

3. *Observations at St. Valery, France*, (lat. 50° 10′ N., long. 1° 37′ E.), *by* H. LARTIGUE, *from Comptes Rendus*, T. XLIX, p. 367.

Near St. Valery a white light of considerable intensity was noticed in the north at $11^h\ 40^m$ P. M. Aug. 28th. A red column, with sides nearly parallel, and 4° or 5° in breadth, rose from the N.N.W. nearly to the zenith, but disappeared after a few minutes. About $12^h\ 10^m$ the white light near the horizon had increased in intensity; a large part of the heavens was colored red, and the exhibition attained its greatest brilliancy at $12^h\ 20^m$. Magnificent columns and brilliant rays, changing from red to green and white, rose to the zenith, sometimes passed beyond it, and occupied the entire space between Aquila and the meridian, and a few minutes later extended to the constellation Auriga. The light was bright enough to allow objects to be seen at a distance of one mile, as during a clear night with a full moon. The illumined portion of the sky increased till $12^h\ 40^m$. After this time the brightness diminished near the meridian, but the east and west portions continued red. At $1^h\ 15^m$ the vertical columns again appeared very brilliant, and nearly as extensive as at $12^h\ 40^m$, but they soon disappeared. The red light grew fainter, and disappeared entirely at 2^h. The white light which marked the commencement of the phenomenon continued three-quarters of an hour longer.

4. *Observations at Paris, France*, (lat. 48° 50′), *by* M. COULVIER GRAVIER, *from Comptes Rendus*, T. XLIX, p. 338.

The aurora was first noticed at Paris at 2^h on the morning of August 29th, and it soon rose to a great height above the horizon. About $2^h\ 45^m$ the vertex of the grand arch had reached the trapezium in Cetus, being 150° from the northern horizon, and it extended from Monoceros to 10° south of θ Aquilæ; having an amplitude of more than 200°. The vertex of the small arch rose to η Draconis, being a height of 26°; and it

extended from Cerberus to Leo Minor, having an amplitude of more than 100°. The exhibition continued until the morning twilight. A motion of translation from W.SW to E.SE. was suspected, but the motion was not very appreciable. When the aurora appeared in its greatest brilliancy, the substance which composed it appeared to be in a state of great agitation; and the rays exhibited a red color, sometimes like that of iron heated to redness and sometimes to a white heat. The space occupied by the small arch was, as usual, of a greenish color; the centre near the horizon being black, and the whole destitute of rays. The aurora exhibited the greatest brilliancy between the W. and N.E. points of the horizon. A few cirrus clouds were noticed during the exhibition; they were all black, without any reflection of the light of the aurora, proving that this light emanated from a region much above that of the clouds.

Magnetic effects of the Aurora; from the Comptes Rendus, T. XLIX, p. 473.

On the 26th of August some anomalies were noticed in the motions of the magnetic instruments at the Observatory of Paris, the declination having changed 22′ between 9½ A. M. and noon.

Aug. 28th at 5 P. M. the motion of all the magnetic instruments was very irregular. Between midnight and 1 A. M. of Aug. 29th the horizontal intensity varied 0·0074. At 9 A. M. of the 29th the horizontal intensity had diminished by 0·01, while the vertical component had increased 0·0013.

During the forenoon of the 29th the declinometer was very much disturbed, and at 11 A. M. it oscillated 41′ on each side of its mean position. Towards evening the disturbances disappeared; but a fresh disturbance commenced on the 1st of September, at $11^h\ 30^m$ A. M. About 4 P. M. Sept. 2d, there commenced a new magnetic storm, more violent than that of Aug. 29th. The magnets were carried beyond the range of their scales, showing a change of the horizontal intensity exceeding 0·014, but as the observations were only recorded photographically, the extreme range could not be determined.

Effect on the Telegraph Wires, from the Comptes Rendus, T. XLIX, p. 365.

From the evening of Aug. 28th until the morning of the 29th the needles of the magnetic telegraph at Paris were almost constantly in motion, as if a permanent current was passing through the telegraph wires. Business was therefore entirely interrupted, and could not be resumed until 11 A. M. Aug. 29th. The same effect was noticed on the telegraph lines from 4^h to 8^h on the morning of Sept. 2d, although no aurora was noticed on that day. Business was again interrupted, the needles were disturbed, and the bells were rung.

The galvanometers were violently deflected, sometimes to the right and sometimes to the left. The needles were turned from zero 10° or 20°, remained there stationary for a short time, then suddenly moved to 30° or 50°, then returned and were deflected in like manner on the other side of the zero point. The effect was more powerful and longer continued on the lines from Paris to Bordeaux, Marseilles and northward, than it was on the east and west lines. During the night of Aug. 29th some intelligible signals were received from Strasbourg.

During the day, Aug. 30th, the telegraph operators experienced frequent interruptions. On the afternoon of Sept. 1st some difficulty was experienced in telegraphing; but Sept. 2nd, at $4^h\ 50^m$ A. M., there was a general disturbance on all the lines, first on those to Bordeaux, Toulouse, Marseilles, London and Brussels, and a few minutes later on those to Basle, Strasbourg, Havre and Brest. At 7 A. M. *bright sparks* were noticed on the conductors of the lines to Bordeaux and Toulouse. The line to Strasbourg was less affected than the others. About 3 P. M. telegraphic communication was resumed on all the lines; but during the evening and the next morning it frequently happened that the communication was difficult.

Observations of Ozone.

Regular observations are made at Versailles on the amount of ozone in the atmosphere. During the auroras of Aug. 29 and Sept. 2, the quantity of ozone was decidedly greater than usual. The following table shows the sums of ozone collected during each period of six days, from Aug. 4, to Sept. 8, 1859:—

	Morning.	Evening.
From Aug. 4 to Aug. 10	64·0	55·6
Aug. 10 to Aug. 16	87·0	59·0
Aug. 16 to Aug. 22	82·0	60·0
Aug. 22 to Aug. 28	65·0	55·0
Aug. 28 to Sept. 2	97·0	64·0
Sept. 2 to Sept. 8	81·0	58·0

5. *Observations at Brussels, (lat.* 50° 51′), by M. QUETELET, from L'Institut of Feb. 1, 1860.

At $12^h\ 35^m$ A. M. Aug. 29th, the sky was overcast with a light and uniform veil, with the exception of the northern horizon, which presented a slight appearance of twilight. Soon there appeared in the N.W. a rosy light, which, in a few seconds, assumed enormous dimensions. It rose to an altitude of 60°, and illumined all that portion of the sky. The rosy light rapidly extended, and soon changed to purple, presenting the appearance of a vast conflagration. There was a constant oscillatory movement, and the light varied from a bright yellow to

the deepest red. Near the horizon the sky presented a greyish and dirty appearance. There were faint traces of an obscure segment, whose centre was on the magnetic meridian. Bright rays of a yellowish white shot up from this part of the horizon, traversed the rosy light in the N. W., and terminated in a bundle at a distance of 90° from their origin.

About $12^h\ 45^m$ A. M., the twilight which illumined all the northern region became more intense; the general tint continued of a yellowish white, but on the eastern and western borders passed into a yellowish green. Then there appeared on the N. N. E. a second rosy light, but less decided than that of the N. W. This was also traversed by yellow rays; but the latter were much more brilliant and broader than those which traversed the light in the N. W. Those rays also terminated in a bundle at a distance of 43° from their origin.

Subsequently the aurora presented frequent alternations of brightness, but the general appearance continued the same until 2 o'clock, when observations were suspended.

At 9 A. M. Aug. 29th a disturbance of the magnetic instruments was noticed at the Observatory. The following table shows the extreme indications of the instruments for each hour, from 9 A. M. to 9 P. M. of Aug. 29th. Between 9^h and 10^h A. M. the fluctuations of the horizontal intensity were too great to be observed by the fixed telescope.

Hour.	Declination. Max.	Min.	Horizontal Inten. Max.	Min	Hour.	Declination. Max.	Min.	Horizontal Inten. Max.	Min.
h. h.	d.	d.	d.	d.	h. h.	d.	d.	d.	d.
9 to 10	50·12	58·63	?	?	3 to 4	53·54	57·55	9·63	4·93
10 to 11	49·33	53·60	1.07	−2·84	4h 30m	57·96	"	8·83	4·60
11 to 12	51·77	55·89	1.89	−0·85	"	57·02	"	5·54	
12 to 1	51·68	53·58	6·50	2·53	6h 30m	56·60	"	3·78	
1 to 2	52·68	53·32	6·47	5·00	8h	55·43	"	6.12	
2 to 3	53·13	53·85	6·04	5·40	9h	55·73	"	5.85	

About midnight Aug. 28th—29th, the employés in the telegraph office at Brussels noticed signals from their bells, such as often occur during a storm. The employés in the offices at Mons, Antwerp, Gand and Ostend were also awakened by their bells, and enquired what was wanted. Communication with Paris, London, and Berlin were interrupted till $1^h\ 30^m$. Paris and London inquired of our operators if they saw a light in the heavens. The effect ceased at $1^h\ 30^m$ on all the lines except the submarine line from Ostend to Dover, which was charged with electricity throughout the entire morning. It was not till $3^h\ 30^m$, and after nearly doubling the battery, that communication was re-established.

September 2, between 5^h and 6^h A. M., there was a second disturbance on all the telegraph lines, and communication between

Brussels, Paris, and London was interrupted. The following observations were made at the Observatory of Brussels:—

Date.	Declination. Max.	Declination. Min.	Hor. Inten. Max.	Hor. Inten. Min.
	d.		d.	
Sept 2, 9 to 10 A. M.	54·75	57·65	10·43	6.25
10 to 11 "	53·62	59·40	9·82	3·36
11 to 12 "	53·72	58·15	0·30	4·64
12 to 1 P. M.	52·06	66·24	8·05	7·36
1 to 2 "	49·34	62·81	?	?
2 to 3 "	43·40	57·87	17·79	0·00
3 to 4 "	48·32	58·40	15·53	10·12
4 to 5 "	51·15	55·00	14·01	10·48
5 0m	54·75		10·24	
6 0	54·44		8·87	
7 5	56·67		7·80	
8 24	56·59		7·21	

Date.	Declination. Max.	Declination. Min.	Hor. Inten. Max.	Hor. Inten. Min.
Sept. 2, 9h 0m P.M.	60·62		5·64	
10 0	53·47		8·04	
Sept. 3, 9 to 10 A. M.	57,17	58·23	4·89	4·09
10 to 11 "	54·56	56·53	5·21	4·46
11 to 12 "	53·73	54·96	7·08	5·55
12 to 1 P. M.	50·59	53·63	10·64	7·40
1 to 2 "	51·03	53·15	11·28	8·88
2 to 3 "	51·63	51·90	10·42	8·75
3 to 4 "	48·37	51·52	13·75	8·36
4 30m	51·52		12·50	
5 0	53·50		14·83	
9 0	57·58		7·31	

6. *Effects of the Aurora upon the Telegraph Lines of Wurtemburg; from Poggendorff's Annalen*, Band 108, p. 506.

During the night of Aug. 28th, from 11h 15m P. M. to near noon of the 29th, there was remarked from time to time on all the telegraph lines proceeding from Stuttgard, an extraordinary attraction of the armatures, which continued from 20 to 40 minutes, and generally appeared first on the line to Heilbronn, after about 5 minutes on the Ulm line, next on the line to Carlsruhe, and last on the Tubingen line. This attraction was repeated every 5 or 10 minutes, and, towards morning, every 2 or 3 minutes. After 5 o'clock only bell signals could be obtained from the local stations, as the armatures were held fast. During this period the deflections of the galvanometers were very remarkable. In a single minute the needles changed their position 5 or 6 times even to 40° west. While on the Ulm line the deviation was easterly, on the Bruchsal line the deviation was westerly.

The cause of this phenomenon is found in a brilliant aurora which was everywhere observed from 9 P. M. Aug. 28th till towards morning of the 29th.

7. *Effects of the Aurora upon the Telegraph Lines of Prussia; from Poggendorff's Annalen*, Band 108, p. 504.

The electrical currents on the conducting wires exhibited themselves in violent deflections of the galvanometers. The needles swung violently from 30° to 70° to one side, returned slowly to zero, and then moved slowly to the other side. On the line proceeding from Berlin westward, the disturbance commenced between 1 and 2 o'clock on the morning of Aug. 29th, when all connection with the stations ceased. Notice had previously been received of disturbance at the easterly stations, Konigsberg, Kowno, Riga and Petersburg. During the day of

the 29th, on the western lines, communication was uninterrupted, while on the eastern lines it was occasionally suspended.

On the 2nd of September, when at 7 A. M. almost all the lines were in use, the disturbance occurred on all the lines, and interrupted communication from 5 to 40 minutes. The interruption was first experienced at Konigsberg 5 A. M.; at Stettin 5^h 55^m; Coblentz and Cologne 6^h 45^m; Berlin 6^h 50^m; Kowno and Riga at 7 A. M. About 9 A. M. the disturbance was greatest, and it declined till 9^h 45^m, when communication was resumed with most of the stations. At Stettin communication on all the lines was resumed at 9^h 24^m, and at Cologne at 10^h. At Konigsberg the disturbance still continued, and at Berlin it increased to 1 o'clock, so that all communication was suspended with the west. In the course of the day, news was received of disturbance at Hamburg, Breslau, Brussels, Paris, and Amsterdam. From the latter station came the intelligence that the submarine line to England was also interrupted by the aurora.

8. *Auroral Observations in Austria; communicated by* Prof. W. HAIDINGER, Vienna, to Prof. SILLIMAN.

The Aurora of Aug. 28th to Sept. 4th, was seen at the following places in the Austrian empire:

	Latitude.		Long.		
Bodenbach, Bohemia,	50°	47′	14°	10′	Aug. 29th, from 2 to 3 A. M.
Schossl, do.	50	27	13	30	From $11\frac{3}{4}$ Aug. 28th to $2\frac{1}{2}$ A. M. Aug. 29th.
Prague, do.	50	5	14	25	Aug. 29th, morning. Also faint in the night from Sept. 1st to 2nd.
Rzeszow, Galicia,	50	3	22	4	Sept. 2nd and 3rd, evening.
Biala, do.	49	50	19	5	Sept. 3, 8 o'clock.
Iristen, Austria,					Aug. 28, from midnight onwards.
Lintz, do.	48	17	14	15	September 3, 8 P. M.
Vienna, do.	48	13	16	23	Great magnetic disturbances were noticed from noon Aug. 28th to the evening of Aug. 29th. Also from Sept. 2 early in the morning to Sept. 3, morning; and from Sept. 4, morning, to Sept. 5th in the evening.
Kremsmûnster, do.	48	3	14	7	Aurora, Sept. 3rd, from $8\frac{1}{4}$ to $8\frac{1}{2}$ P. M.
Schemnitz, Hungary.	48	27	18	50	From Aug. 28th, 10 P. M. to Aug 29th, 3 A. M. Also Sept. 3rd, 9 P. M.
Neutra, do.	48	17	18	50	Sept. 3, 9 P. M.
Mitterdorf, Styria,					Sept. 2, evening.
Laibach, Carniola	46	3	14	30	Sept. 3, after 8 P. M.

9. *Effects of the Aurora upon the Telegraph Lines of Switzerland; from the Comptes Rendus,* T. XLIX, p. 662.

The intensity and direction of the currents excited in the telegraph wires, during the aurora of September 2d, were determined by M. Hipp, at Berne, by the deviation of a magnetic needle, surrounded by a wire, making thirty coils. The regular current employed in telegraphing should have a sufficient force to deflect this needle 30°. M. Hipp found that the short lines gave no indication of a current, while the most marked effects were indicated by the longest lines, and especially by those which were directed from north to south, as the line from Zurich to Berne, Fribourg and Lausanne. The current on this line, directed from Zurich to Lausanne, would increase gradually, until the needle was deflected 42°. It would then slowly decline, and at the end of two or three minutes become zero. It would then change its direction, returning from Lausanne to Zurich, and attain a maximum of 30 degrees. The latter current, after continuing 60 or 90 seconds, became zero, and again changed its direction.

It appears from these observations that two currents succeeded each other on the telegraph wires, having a general direction from north to south, the one proceeding from north to south having a double intensity and a double duration, the other proceeding from south to north having a less intensity and a less duration.

M. Hipp obtained deviations of 58 degrees between Zurich and Berne, and of 64 degrees between Berne and Basle, indicating currents at least threefold the ordinary current employed in telegraphing.

10. *Effects of the Aurora of Aug. 28th and 29th upon the Telegraph Lines of Tuscany, by* M. CH. MATTEUCCI; *from the Annales de Chimie et de Phys.,* Tom. LVII, p. 419.

About 6 A. M., Aug. 29th, the disturbance became sensible on the telegraph lines. About 10 A. M. a current, which marked 25 degrees on the galvanometer, and equal to about 30 feeble elements of Daniell, traversed the upper wire of our telegraph lines, in the direction from Pisa to Florence. The current slowly increased, attained its maximum in about five minutes, and then rapidly declined. These periods were renewed a great number of times, and, during the intervals, telegraphic communication was held in the usual manner. About 3 P. M. the auroral effect upon our telegraph lines had ceased.

During the disturbance, on all the lines where there are several wires stretched one above the other in the same vertical plane, the strongest current was uniformly observed in the upper wire, while in the wire nearest the earth, the current was either feeble

or inappreciable. This extraordinary current was the most intense on the longest wires.

11. *Observations at Rome, Italy, (lat. 41° 54′), by* M. Secchi; *from the Comptes Rendus,* T. xlix, p. 347 and 458.

On the 29th of August we had a superb aurora. The sky at Rome was covered with a red veil, and was crossed by the most brilliant rays, in the form of luminous columns. The magnetic instruments were very much disturbed. The declinometer deviated 34′ from its normal position, and the inclination varied 42′. The instruments for measuring the horizontal and vertical force both passed beyond the range of their scales, showing that the variation of the horizontal force must have been at least 0·0135, and of the vertical force at least 0·0075. The disturbance continued for a long time during the forenoon, and the vertical magnet, which, before noon, was beyond the scale, in consequence of the elevation of its north pole, at one o'clock passed beyond the scale on the opposite side, from a depression of its north pole.

A still more remarkable disturbance of the magnetic instruments occurred on the 1st and 2nd of September. At 4 P. M. Sept. 1st, the vertical magnetometer passed beyond its scale, showing a diminution of vertical force.

Sept. 2, at 7 A. M., the magnets were very much disturbed. At $7^h\ 10^m$ the declinometer pointed 2° 50′ to the west of its ordinary position. After this the needle returned rapidly to the east, and at $7^h\ 30^m$ pointed 1° 23′ east of its mean position, thus describing an arc of 4° 13′ in less than half an hour. This disturbance is the more remarkable, as the greatest range heretofore observed at Rome was only 45′ or 50′.

The bifilar indicated a diminution of the horizontal component, amounting to 0·129, or about *one-eighth* of its mean value.

These disturbances continued with variable intensity all day. At $4^h\ 15^m$ P. M. the vertical magnet again passed beyond the range of its scale. At 9 P. M. the magnet was more tranquil, and at midnight they had all returned nearly to their normal condition.

The variations of the declinometer, the bifilar and the vertical magnetometer were not simultaneous, but their maxima occurred at different times. The great vibrations were cotemporaneous with the currents observed on the telegraph lines. The clouds observed in the heavens had the exact appearance of those of the aurora borealis when it occurs by day, and such as were noticed at Rome Aug. 29th.

Similar observations were made at Leghorn, where at $6^h\ 30^m$ A. M. Sept. 2nd the declination was 15° 10′, while at $6^h\ 30^m$ P. M. it was only 14° 18′. The inclination of the magnetic needle was also very much increased during the day.

12. *Observations from Western Asia.*

A. Yozgat (lat. 39° 45′), by FAYETTE JEWETT, M.D., American Missionary.

The auroral phenomena referred to in your circular were *not* observed at Yozgat. On the 28th of August, and for several days before and after that date, I was in Arabkir, a town nearly 300 miles almost east of Yozgat. The aurora was not noticed there. While I was at Arabkir, owing in part to the mildness of the temperature, and also to the peculiar clearness of the atmosphere, my attention was almost every evening directed to the study of the constellations. The natives, too, at that season, slept upon the roofs of their houses.

B. Kharpoot, (lat. 38° 40′), by Rev. C. H. WHEELER, American Missionary.

Aug. 28th and the following nights nothing unusual was seen here by me or by others of whom I have made inquiries. It is also a fact, so far as I know, that the usual displays of the aurora are less brilliant here than in New England.

C. Mosul, (lat. 36° 22′), by H. B. HASKELL, M. D. Missionary Physician.

No unusual appearance was observed Aug. 28th, 1859, either here, at Mardin, or Diarbekir. During the residence of American missionaries in Mosul (ten years) no auroral phenomena have been noticed.

13. *Observations in the Southern Hemisphere.*

Ship Southern Cross, (near lat. 50° S., long. 80 W.), from the Alta California.

On the night of Sept. 2d, during a tremendous gale, the rare spectacle of an aurora australis was witnessed. It commenced about half-past one o'clock in the morning, and increased in splendor until towards daylight, when it gradually faded before the light of day. The whole heavens were of a deep red, which color was reflected from the ocean. During the night a tremendous squall with hail burst upon the ship. Through the whole of this the flames assumed the same roseate hue; and when a spray flew over the ship, it fell to the leeward in ruddy showers. Between the squalls, in the clear places in the sky, the mysterious lights were seen shooting up in spiral streaks nearly to the zenith now flashing out with meteoric brilliancy, and now looming up against the horizon, as with the blaze of some terrible conflagration. During the gale, several times at night, brilliant balls of fire appeared flickering at the mast-heads, yard-arms, and other salient points. The captain and his officers say that they have never witnessed anything equaling this display for magnificence.

14. *Observations at Concepcion, Chili, (lat. 36° 46′), from the Mercurio of Valparaiso.*

An aurora was visible here on the nights of Sept. 1st and 2nd. It appeared at midnight in the south part of the horizon, and

was visible until two o'clock in the morning. It had a movement of translation from east to west. In appearance it resembled a cloud of fire, or a large ignis fatuus, which threw out some flame or vapor, and spread a light like that of the moon. For more than an hour the city was brilliantly illuminated by this heavenly light.

15. *Observations at Santiago de Chili, (lat.* 33° 28′), *from the Mercurio of Valparaiso.*

On the morning of Sept. 2nd, about two o'clock, the sky to the south of Santiago was brilliantly illuminated by a light, composed of blue, red, and yellow colors, which remained visible for about three hours. This phenomenon is very rare in Chili. The aurora was also seen in Valparaiso (lat. 33° 6′).

15. *Observations at Kapunda, South Australia, (lat. about* 35°), *by* J. B. Austin; *from the London Times of Nov.* 14, 1859.

On Monday evening, Aug. 29th, just after dark, the aurora appeared like a large and brilliant pink cloud, extending about 25° or 30° above the horizon, and 60° or 70° in length. It continued visible for about twenty minutes, during the last five of which, splendid streamers of pink and white light were shooting vertically through it. It was seen almost throughout these colonies at the same time, and on four nights in the same week; but I saw it only twice, once Aug. 29th, and again on Friday, Sept. 2nd, when the most gorgeously brilliant display took place. It commenced immediately after sunset, and increased in splendor during the evening. For several hours, little was to be seen but a deep rich pink light over the southern part of the sky; but by degrees it extended, and, about nine o'clock, a huge pillar of fire appeared in the west, where it remained until midnight. After the moon went down, the brilliancy of the aurora increased, and from about half-past eleven till past twelve, a beautiful pale, soft, greenish-blue light, like the dawn of morning, extended itself above the southern horizon for about 100° or 110°, and about 18° or 20° in height. From this, streamers or radii of red, white and blue light shot upward to beyond the zenith, fully half the sky being covered with this splendid illumination, the light from which equalled that of the full moon in England. These radii converged towards a point about 15° north of the zenith, but did not themselves extend more than half that distance beyond the zenith. This was its last appearance, and a splendid finale it was. The powerful electric excitement in the atmosphere had an extraordinary effect on the telegraph wires, agitating the instruments violently in some places, and quite interfering with the transmission of messages.

ART. XXXVI.—*Geographical Notices;* by DANIEL C. GILMAN, Yale College Library. No XII.

REPRINT OF A TRACT, BY NICOLAUS SILLACIUS, (A. D. 1494), ON THE SECOND VOYAGE OF COLUMBUS.—Although the principal object of these "Geographical Notices" is to record the recent progress of our knowledge of the world, yet we cannot forbear to make mention of a remarkable publication which pertains to the discovery of the New World at the close of the fifteenth century.

Christopher Columbus, in his second voyage across the Atlantic, set sail from Cadiz, September 25, 1493. Soon after his return, Guglielmo Coma wrote from Spain to Nicolaus Sillacius in Pavia an account of the journey. These letters were translated by Sillacius into Latin, and such other information was added to them as could be gathered from current reports; and this whole account of the voyage of Columbus, was published under the title, "*De Insulis Meridiani atque Indici Maris nuper inventis.*" This curious tract has been almost forgotten for nearly four hundred years; and, at the present time, but two copies of the original edition are known to be in existence,—one belonging to the Marquis Trivulzio of Milan, and the other to James Lenox, Esq., of New York. The last named gentleman, with characteristic liberality, has made this pamphlet accessible to all scholars, by causing it to be carefully re-printed in the original Latin, with an English translation by Rev. James Mulligan, a biographical introduction, notes, and a bibliographical appendix, in which much important information is given in respect to the early printed account of the various voyages of Columbus. The whole work forms a quarto volume of about 180 pages, printed in a truly elegant style.

It cannot be expected that this tract will add very much to what is known from other sources of the great navigator and his voyages, but as a contemporaneous record of most important discoveries, the volume will always be prized not less by the geographer than by the historian and bibliographer.

VOYAGE AROUND THE WORLD OF THE AUSTRIAN FRIGATE NOVARA.—The reference which has been made in a previous page of this number of the Journal to the Austrian circumnavigatory voyage, furnishes us with an appropriate occasion for speaking of that exploring expedition.

The Imperial frigate "Novara," under the command of Commodore von Wüllerstorf, set sail from Trieste April 30, 1857, and returned to the same port August 26, 1859, having successfully completed a voyage of scientific observation around the world,

the first which was ever undertaken by the Austrian Navy. It is of course too early for the results of this expedition to be fully made public, but various accounts of the whole voyage, and of particular observations, have been given in the journal of the Geographical Society of Vienna, and in Peterman's *Mittheilungen*. *L'Institut* of Paris has also published a series of articles on the subject, communicated by M. Marschall of Vienna.

The "Novara" is a frigate of 1800 tons burthen, and 44 guns. It was manned by 354 men. The scientific corps, in addition to the commodore and other naval officers, consisted of the following naturalists, viz., Dr. Hochstetter, physicist and geologist; Frauenfeld and Zelebor, zoologists; Dr. Scherzer, ethnologist, having charge also of investigations in national economy, the botanist Jellinek and the artist Selleny.

Sailing, as we have stated, from Trieste, the expedition touched for longer or shorter periods at Gibraltar, (eleven days), Funchal, (nine days), Rio Janeiro, (three weeks), Table Bay, Cape of Good Hope, (twenty-four days), Island of St. Paul, (seventeen days), Point de Galle, (eight days), and Madras, (eleven days). Sailing from the last named port Feb. 10, 1858, from that time until August 11, a period of six months, the vessel was directed to various island and continental seaports of south-eastern Asia, including Nikobar, Singapore, Batavia, Hong Kong, Shanghai, etc. In September the island Puynipet was visited, and afterwards Sydney, (a month), Auckland, (seventeen days), Papeiti, on Tahiti, (eleven days), Valparaiso, (twenty-four days). Leaving the latter port May 11, 1859, the Novara reached Trieste at the end of the following August. The whole extent of the voyage was nearly forty thousand nautical miles.

Various letters and partial reports, submitted to the Academy of Sciences in Vienna, have already been printed, and a complete narrative of the voyage, and full reports of all the scientific observations which were made upon it, is soon to be prepared and printed.

Dr. Hayes's Proposed Arctic Journey.—A meeting of the American Geographical and Statistical Society was held in New York, March 22, for the purpose of encouraging Dr. Hayes in respect to his proposed voyage to the Northern ocean. Dr. Hayes was present, and, in addition to his statements, an eloquent exhibition of the importance of this expedition, together with an appeal for material aid, was made by Dr. Francis Lieber.

Hon. Geo. Folsom, E. H. Vielé, Esq. Profs. Mitchell and Silliman, and Dr. A. H. Stevens also took part in the meeting, and letters were read in approval of the undertaking from Profs. Bache, Henry, Guyot, Dr. Gould, etc.

The general purpose of Dr. Hayes has already been set forth

in this journal, in a paper from his own pen, "On the Practicability of Reaching the North Pole," (vol. xxvi, p. 305–23, Nov., 1858.) At the recent meeting it was stated that ten thousand dollars had already been subscribed in aid of his enterprise, and at least ten thousand more are needed to insure the sending forth of the expedition.

The various weighty problems which are proposed for solution, especially the determination whether or not there be an open Polar Sea, present the strongest claims to the liberal contributions of all who are interested in the promotion of geographical discovery, or in the progress of physical science.

JOURNAL OF THE AMERICAN GEOGRAPHICAL AND STATISTICAL SOCIETY.—We are informed that this Journal, which has heretofore been published monthly, will hereafter be issued quarterly each number comprising at least 128 royal octavo pages. The first number, announced for the month of April, will comprise nearly 150 pages, consisting in part of original articles by the following writers: Commander Matthew F. Maury, Prof. Alexander D. Bache, Prof. Arnold Guyot, E. George Squier, Paul B. Du Chaillu, Dr. David Livingstone, Joseph C. G. Kennedy, James Wyne, M.D., together with late geographical and statistical intelligence, and careful notices of new scientific works bearing upon the objects embraced in the Society's labors. The subscription price to those not members of the Society will be three dollars a year.

Letters in reference to any matters connected with the Journal should be addressed to DANIEL WILLARD FISKE, General Secretary of the Society, New York.

EXPLORATIONS IN THE AMOOR REGION.—We have already called attention to the great efforts which are making by the Russian government to ascertain the resources and characteristics of Eastern Siberia, and to bring the immense region drained by the Amoor and its tributaries into connection with the commerce of the world. To our own countrymen, these investigations are especially important, when we consider the probable effect which will be produced upon the commerce of the Pacific.

At a recent meeting of the Royal Geographical Society of London, a paper was read, presenting extracts (prepared and translated under the direction of Capt. R. Collinson) from various official Russian reports, respecting the districts adjacent to the Amoor river, These extracts from the writings of Messrs. Pescurof, Vasilief, Radde, Usoltzof, Paragchefski, etc., are printed in the Transactions of the Royal Geographical Society, vol. 28,—together with an original map compiled by J. Arrowsmith. As our space at the present time allows us to quote but one of these reports, we have selected that by M. G. Radde, upon the table lands east and

southeast of the great Lake Baikal—or, as he terms it, the Dáuro-Mongolian Frontier of the Trans-Baikal region.

"If by the word 'Steppe' be understood an extensive, treeless and arid plain, without any considerable undulations, that term cannot, in its full sense at least, be applied to the tracts now under consideration. Scientifically, and with regard to the formation of its surface, this region should be described as an elevated extent of country, intersected by many bare mountain ranges; the valleys and low plains between which are in some places strongly impregnated with salt, and produce exclusively *chenopodeæ* whilst in others they receive the waters of many small springs and atmospheric moisture in the shape of snow and rain, giving rise to innumerable small, turbid, and muddy lakes, seldom containing water fit for use, but more often contaminated with saline and alkaline solutions. An ordinary observer, one who has not penetratrated into the external structure of the earth's surface, or, what is of greater importance, into the properties of the soil from which he derives his sustenance, would see here only a contrast of conditions, namely, the contrast of the wooded surface to the treeless and bare, inducing him to call such a country a steppe. Whether the latter surface be level, or high and undulated, it would equally by him be termed a steppe; and only perhaps in distinguishing two contiguous regions would the mountainous and desert zone be designated as the 'high' steppe.

The Dáur country on the Mongolian frontier cannot, both with relation to its absolute height and its topographical features, be even approximately compared to a regular steppe; nor can any parallel be drawn between the chemical properties of their vegetable strata. Whilst in many regions, as for instance in the extensive Orenburg, Taurida, and Bessarabian steppes, the chernozem, so favorable to cultivation, penetrates the surface to 2 and 3 feet, there is a total absence of organic matters in the woodless valleys of the Dáurian frontier table-lands; and the soil of that extensive region has not undergone any considerable change for many centuries, owing to all the elevations, and frequently the valleys, abounding in siliceous ("jasper and flint") formations, which either do not admit of precipitation at all, or with great difficulty; added to which, the decomposition of hard rocky masses is materially retarded by the dryness of the atmosphere, and the want of snow and rain.

A further exposition will show that, leaving aside the peculiar stamp which characterises the organic nature of this region, the material and moral condition of its scanty population have succumbed to the influence of the physical conditions above-mentioned. The greater part of this desert track, perfectly unsuitable for the production of grain, is apparently, like the inhabited regions of the Gobi desert on the south, destined by na-

ture for the nomadic life of the wild and superstitious Mongol, who, spurning the ties of a fixed abode, scours the level plain on his fleet steed.

With respect to geographical position, the Dáurian frontier-steppes occupy a narrow zone between longitude 112° 30′ and 119° E.; their chief extension is from west to east, and they are only in a few places intersected by the parallel of 50° N. latitude. If the treeless elevations are alone to be denominated steppes, the boundary of the Russo-Dáurian steppes must be drawn southwards from Nijni-Ulhun frontier station, as the mountains on the banks of the Onon, extending farther west, are covered all over with dense forests; on the east, on the other hand, from the above station, and between Akshinsk and Mogoitu, along the right bank of the Onon, extends a forest of tall trees, the predominating family of which, the pines suddenly disappears a few versts east of Mogoitu, and is succeeded by a straggling wood of birch, as far as Kubuhai.

The steppe district thus only crosses the Onon at Niji-Ulhun, occupying also a small zone, well irrigated with numerous small streams, on its left bank.

In its easterly extension, parallel to the course of the Onon, the steppe is not bounded on the north by this river, but by a very thick forest extending between the Onon and the desert, in some places 10 miles in breadth. This forest is worthy of notice for its historic associations as the sojourn of Chingis-Khan, and also in a botanico-geographical respect, forming, as it does, a natural boundary between the river and the steppe, which is remarkable for its small breadth and its clearly defined limit on the south. The forest thins gradually towards the east, down the Onon, and terminates entirely at the place where the river bends abruptly to the north on meeting the western spurs of the Adoncholon mountains; farther in that direction, with a lesser fall, and often contracted between banks of granite, the river pursues its course as far as its confluence with the Shilka, through a wooded country more frequently overgrown only with bushes.

The frontier steppe, which has already a breadth of about 53 miles between the old Chindan fortifications and the Uldza river, extends towards the south along the confines of this pine forest, acquiring a greater width farther on. The Onon-Borza* rivulet, flowing from the northeast, and which likewise approaches the southern offshoots of the Adoncholon mountains at 116°, and after bending to the north unites after a course of twenty miles with the Onon at Ust-Borzinsk, belongs at its western middle course to the steppe region. In like manner, the more sloping southern

* This stream is called Onon-Borza in distinction to the three Borza rivulets which fall into the Argun.

declivities of the Adoncholon mountains, of which the summits alone are overgrown with stunted birch-trees (these are often, however, found in great density along the entire northern slope of that chain), are referable to the same region.* To the eastward, however, almost on the meridian of Tsagan-olu (116° 43′), two rows of woody elevations extend from east to north, intersecting each other at the most westerly lower range of the Buko-Hada, where the eastern branch terminates. The bare elevations running from this knot to the south expand the farther they extend, and form, near the frontier, the wooded table-land of Altangan, so called after one of its principal valleys.

The abovementioned mountains, which terminate in Buko-Hada, form first on their eastern, then on their northeastern extension, a water-shed between the affluents of the Onon and Argun; the Gazimur river takes its rise on its northern side. The Altangan table-land lies between two systems of saline waters; the lake of Tarei-nor is the largest representative of the western basins, whilst to the eastern belongs Ubudk, Tsagan-nor, Hara-nor, and many others. The culminating points of this region occur in the Steppe district, which here increases in width, being more than 67 miles in breadth between Tsagan-olu and Abagaitu. Having by barometrical measurement taken the height of Tsagan-olu at 2711 feet English, 500 more must be added for the mountain pass of Soktui. Only one valley, the largest and broadest of those occurring in the frontier steppes, on the Russian side, intersects the Altangan plateau from east to west, continuing on the other side of the mountains from their western slopes.† This is the valley of the Urulungui rivulet, which flows for 100–113 miles in a direction towards the Argun, and terminates there at Novo-Tsuruhaitui military station. At its lower course, the Urulungui flows gently along a winding channel, bordered at first occasionally by bushes of the willow, the precursors of a more luxuriant vegetation than that of the steppe. The region, however, between the Urulungui Argun, and Altangan plateau loses its vegetation more and more towards the south; on the frontier at Abagaitu it is intersected by parallel

* In Dáuria trees and bushes are only found on the northern slopes of mountains from two causes. The first is, that the southern slopes are much drier than the northern, which longer preserve the moisture of the soil, and so assist vegetation; whilst almost every plant withers in summer on the southern side of the mountain. The second cause is attributable to the circumstance that the fires which occur in the steppes in spring become sooner extinguished on the north side than on the opposite, where the snow leaves the ground earlier (being, in fact, perfectly dry by the end of February), thus offering no obstacle to the spreading of the fire. The limits of wood and bush vegetation are not governed in these regions by the rigor of the winter, but solely by the dryness of the soil and sultriness of the summer months.

† The Urulungui valley probably commences in the vicinity of the Chinese frontier, to the west of the Altangan plateau.

40° 35′ and is so unproductive and barren, that on that account alone, and without reference to its topographical features, it may be considered the extreme northeastern end of the Gobi desert, which extends to the lakes of Buir-nor and Dalai.

Broad, light-green, and low tracts, overgrown with reeds, and winding only along the very edge of the Argun, intersect the bare and rocky desert, the uniformity and character of whose vegetation is at last broken by the Urulungui rivulet, at Novo-Tsuruhaitui. Lower down from the mouth of that stream the valley of the Argun assumes another aspect; and the river itself, taking a bend to the northeast, visibly contracts and flows more rapidly. Here the chernozen soil of the valley with its diversified flora also makes its appearance, so that the Urulungui may not only be considered as the limit of the high Dáurian steppes, but also the sharply-defined natural boundary of their vegetation.

To the north of the Urulungui commences the district of the metalliferous deposits of the Nertchinsk mountain region, remarkable also for its vegetation, which, lower down in the valley of the Argun, is very rich in forms, particularly at Chalbuchi village. It is here that the Mongolian oak, the Corylus heterophylla and Betula dahurica, seen nowhere in Siberia, first occur. Lastly, possessing a sufficiently thick population, some portions of this region are highly favorable to the production of cereals; but it is less adapted to the depasturage of cattle than the steppes, on account of the many mountains by which it is intersected.

To describe in a few words the boundaries of the high Dáurian steppes, it suffices to say that their limit on the north is formed by a pine forest, extending along the right bank of the Onon, by the Onon-Borza rivulet and the Adoncholon mountains, together with the elevations at the upper courses of the Gazimur and Urulungui rivulets; on the southeast by the Argun; and on the south by the Chinese frontier laid down in 1727; the western extremity of the steppe being bounded by the forests on the right bank of the Onon,

The whole of this country, occupying an area of 380 square miles, attains an absolute height of 2200 (English) feet at its greatest depressions (namely, at Kulussutaefski military station at Bayrn-Tarei lake), and almost 3000 feet at its highest elevations. Numerous mountain chains, rarely however detaching isolated spurs, intersect it in various directions, forming broad valleys, with a saline soil, and which are often found to contain accumulations of precipitated Glauber salt and soda, but seldom any water-basins. Even where the latter occur, they never attain any considerable depth, and are mostly so shallow and level that after a snowless winter or hot summer they completely dry up and frequently

remain in that state for many years. The most striking example of this is afforded by the great Baryn-Tarei lake, lying south of the Kulussutaefski frontier station, which was found dry by Pallas in 1772: since then it filled with water, which again entirely evaporated five years ago, so that it now only presents a dry saliferous and muddy bottom, cracked in numerous wide fissures by the burning rays of the sun. With the exception of a few rills, generally filled only by snow water in spring, and remaining perfectly dry during the greater part of the year, a small number of spring morasses are alone to be found there. Not unfrequently such morasses occur in the vicinity of saline lakes; but often, having no efflux, they drain themselves, when, owing to the pressure of water beneath, the surface around their swampy edges rises several fathoms in winter with its icy covering. The ice remains in such places until the middle of summer; and even so late as the month of June have I seen on a freshwater morass near Kulussutaefski, in the neighborhood of Tarei lake, blocks of ice one inch thick, capped, as it were, with a layer of earth of the same thickness, overgrown with reeds.

With such a scarcity of water and so great an elevation, it is conceivable that the atmosphere of this region must be very dry. To the south of this frontier zone, at the same time, extends an immense desert, and on the north, the rain-clouds, being attracted by a dense forest, and arrested by elevated ranges, discharge their waters to superfluity over the wooded district of Nertchinsk; whilst some 7 to 14 miles to the south not a drop of rain or dew will fall for months together. At the village of Tsagan-olu, I witnessed, at the beginning and latter part of the month of June, examples of such an unequal distribution of moisture; whilst the heaviest rains and storms, continually interfering with my excursions, prevailed at midday in the forests only 5 miles to the north, buckwheat was being scorched 3 miles to the south of the village, and no rain had fallen since the middle of May at the frontier stations of Soktuisk, (40 miles farther to the south), and Kluichefski and Chindan (33 miles more westerly). It is to be regretted that scarcely any observations on the moisture of the atmosphere of this elevated region have hitherto been made, as, together with a better knowledge of the chemical properties of the soil, they might have led to some definite conclusion on the greater or lesser fitness of the country for agriculture. At the same time we find that almost useless experiments on the growing of corn have for many years been repeated with great perseverance at the military settlements on the frontier. In none of the extensive and remote regions of Russia, in the same latitude, are there, probably, presented so many local conditions unfavorable to agriculture as in the frontier steppes of Dáuria; and it is very doubtful whether, even with increased

labor, and the introduction of a better system of tillage, any regular or even moderate harvests can be obtained. Not only is there on one side the want of rain and snow, and the great elevation to influence the early autumnal frosts, but on the other the very properties of the soil offer still greater obstacles to cultivation; to be surmounted perhaps only by a Chinese density of population, and Chinese industry.

The very soil of these regions is of a twofold nature: a great part of the steppes, and all the mountain-chains in particular, are as if sown with flint, jasper, and chalcedony, deeply buried in a hard argillaceous sand, and forming also the upper vegetable strata, which present no traces of fertility; whilst all the depressions of the surface are impregnated with salt, and therefore produce only a few saline plants. The climate is at the same time unfavorable to the growth of any plant. Severe snowless winters prevent the cultivation of winter wheat, while the early autumnal frosts are generally prejudicial to crops, and impede the fallow tillage. Spring wheat and buckwheat are consequently alone sown; and even these crops perish in great part from the droughts in May and June, no shade being afforded to their roots by their thin foliage and feeble growth of stem, which rises only one foot from the ground. As a rare exception, a snowy winter will sometimes follow a series of dry years; but this, although acting beneficially on the fields, is of great injury, by its long continuance, to the cattle, which are not unfrequently entirely destroyed by the want of fodder. Under ordinary climatic conditions, the want of snow is the chief impediment to their safely passing the winter; so that, on the freezing of the few fresh springs, the animals suffer much more from thirst than from hunger, and from the first half to the end of December are often so reduced that, even with a sufficiency of food, they are unable to survive the second half of that month.

Appreciating the advantages which Eastern Siberia derives from the opening the Amúr to commerce, Mr. Radde proceeds to consider the present agricultural wealth of the Dáurian Steppes, and its future influence and development. The first part of the paper has already shown the unproductiveness of the country, and the great obstacles presented by its climate. Cattle-breeding and sheep-farming in particular, would alone appear to admit of some development, as the lowlands and steppes afford good pasturage; and the prejudicial climatic conditions might, with perseverance, foresight, and industry, be rendered less unfavorable.

Wool is the only article which Mr. Radde adduces as an export, and he considers there will be no difficulty in finding a mar-

ket for it in the United States. The frontier region of Dáuria and Mongolia is capable, the author thinks, of producing two millions of sheep; whilst cattle-rearing must for some years remain in its present state, owing to the scantiness of population, and the difficulty of making provision for the winter."

KHANIKOFF'S TRAVELS IN PERSIA.—Through the attentions of D. W. Fiske, Esq., General Secretary of the American Geographical Society, we have received the *Proces-Verbal* of the meetings of the Imperial Geographical Society of St. Petersburg, held Dec. 16, 1859, and Jan. 13, 1860.

At the latter sitting, M. Khanikoff presented an account of his researches in Persia, to which, in a former number of this Journal, a brief allusion was made. His remarks were chiefly directed to the Province of Khorassan, as will be seen from the following abstract which we translate from the *Proces-Verbal.*

The limits of this vast province, bounded on the north by a plateau which stretches in the direction of latitude from Hindou-Kousch to the southern extremity of the Caspian Sea, and toward the west by another plateau, making an angle of from 20 to 30 degrees with the meridian, are far less clearly defined toward the east. This traveller is of the opinion that Khorassan may be justly considered as bounded in this direction by the western slopes of Hindou-Kousch, which stretch from Hérat to Kandahar, as well as by the mountains which separate Séistan from Béloudchistan. The space thus enclosed presents four natural sub-divisions, to which M. Khanikoff gives the name terraces. The first embraces the salt desert lying between Kaschan, Koum, Bastam, Nichibour, and Tebbès. Its general inclination is directed from northeast to southwest, and its lowest point is on the line joining Bastam and Tebbès. The second comprehends the dry desert of Lut, and toward the north borders on the preceding; the mountains of Kirman are its southern limit; its general inclination is from north-northwest to south-southeast, and its lowest point is probably no more than 500 feet above the level of the sea. The lowest point of the third, which includes Séistan, is at the surface of Lake Hamoun, of which the waters are 1,545 feet above the level of the sea. Finally, the fourth terrace, which is the least extended, is bounded by the line which, on one side, joins Birdjand and Sebzar, and on the other stretches from the first of these villages to Toun, Haff, and Yezdoum; its general slope inclines from southwest to northeast. The limits of these four divisions of Khorassan are not everywhere well defined, but they are clearly indicated by the directions of the water courses and the inclinations of the ravines. The northern frontier of Khorassan coincides with the isothermal line of 12° Cent., a fact which gives plausibility to the conclusion, that over all the expanse of the northern plateau of cen-

tral Asia, from Orenbourg to Meshed, over a space of 20 degrees in breadth, the annual temperature seldom falls to 6° Centigrade; at the southern limit of the first terraces described above, date trees grow and produce fruit in abundance, from which we must conclude that the annual temperature here is not below 18° Cent.; hence, in this direction and in moving toward the equator two geographic degrees only, the mean annual temperature acquires an increase equal to that gained to the north of Meshed by a progress of 20 degrees along the meridian. M. Khanikoff calls the attention of the Geographical Society to this point, that the rapid elevation of the degree of the annual temperature cannot be explained by the astronomical and hypsometrical coördinates alone, of the regions where this increase has been observed. He thinks that one of the essential causes to which it should be referred is the dryness of the air, which rapidly increases from the southern shore of the Caspian Sea to the frontier of Béloutchistan, so that in the desert of Lut the atmosphere contains only $\frac{1}{10}\frac{3}{0}$ths of relative humidity.

After entering into detail relative to the probable limits of the highest temperature, determined from the softening observed in the stearine which was in the baggage of the members of the expedition, M. Khanikoff has described some of the most striking atmospheric phenomena which he has himself studied in Khorassan. He mentions, among others, waterspouts and whirlwinds of dust, the dry mist, the atmospheric fluctuations, the mirage, and finally, observations upon the zodiacal light, which was seen by the expedition while traversing the space between Anarderré and Kirman. In conclusion, M. Khanikoff presented to the assembly the whole trigonometrical network, by aid of which the sketches which he has traced were drawn, adding the details of the circumstances which accompanied the operations. For want of time he reserved to another meeting the enumeration of the ethnographical labors of the expedition.

ART. XXXVII.—*Correspondence of Prof. Jerome Nicklès, of Nancy, France, dated Feb. 26th, 1860.*

French Academy of Sciences. Public meeting and distribution of the prizes.—This meeting was held Jan. 30; it was concluded with the eulogy upon Thénard, pronounced by Flourens, one of the Perpetual Secretaries. The following is a summary of the principal prizes awarded.

Prize for Astronomy.—This prize was awarded to Robert Luther, for the discovery of *Mnemosyne*, the only new planet of the year 1859. Mnemosyne is the 57th of the group of telescopic planets between Mars and Jupiter, and the 8th of those which are due to Mr. Luther. The

Academy has already four times awarded the prize to this astronomer for the discovery of the five planets, Thetis, Proserpine, Bellona, Leucothea, and Fides.

The prize for Mechanics was awarded to Mr. Giffard for the invention of a new feeding apparatus for steam boilers, which he calls an "*automatic injector.*" The report, made by Combes, gives great praise to this apparatus. The injector very advantageously replaces the feeding pumps of steam boilers. In addition to the fact that it avoids all loss of heat, other than that which results from the cooling of the exterior of the tubes in which the steam and hot water circulate, the absence of any movable solid parts, exposed to wear and derangement, the extreme facility with which the quantity of water supplied can be regulated between limits sufficiently narrow, &c., render it very valuable for locomotive machines. Accordingly several great railroad companies have already applied it to machines of this kind.

The automatic injector takes its origin from an observation made by Savart in 1832, in his experiments upon the fall of liquid veins; a current let fall from a vessel where the level is maintained at a given height, penetrates directly and quite unbroken into a vessel where the surface is less elevated.

The observations of Savart; the phenomena, long known, of the communication of lateral motion to fluids by which is explained the action of those blowing machines called *trompes;* the forcible drawing in of air through the intervals which separate the bases of the tuyeres of high furnaces; the effects of the blast pipe of locomotive engines, &c., have given Mr. Giffard a hint which has led him to the invention for which the Academy have just awarded a prize.

Mr. Giffard, who is a person of very earnest spirit, is known in France by his attempts at guiding balloons. Some years since he obtained evident results in directing them, since he succeeded in making his balloon move *against* the *wind*, at the Hippodrome in Paris. This fact was stated in a report signed by intelligent men. Although without means to continue his researches upon this point, Giffard was not discouraged. Instead of making a show of his misery, and representing himself as persecuted by science, or as a martyr to an idea, he left balloons for the time and set about the construction of locomotive machines; he thought of his injector, and put off his researches upon ballooning until by his labors he should again be furnished with means to continue them; complete success crowned his investigations; he has now placed himself in a condition to take up again his favorite pursuits.

Physical sciences.—A prize has just been divided between Daubrée, Dean of the Faculty of Science at Strasbourg, and Delesse, mining engineer at Paris. The question proposed for competition was in respect to the *Metamorphism of Rocks.* The report of the committee will not convey to the readers any more knowledge than they have already obtained from this Journal which has often made mention of the labors of Messrs. Delesse and Daubrée.

The *Prize for experimental Physiology* has been awarded to Pasteur for his researches in regard to *fermentation.* They bear upon *alcoholic fermentation, lactic fermentation,* and *tartaric fermentation,* and of their

isomeric compounds. The report of the committee has particular reference to the physiological side of the question; it was edited by Claude Bernard, an eminently distinguished physiologist. The following extract is from the report:

Following the example of Cagniard Latour, Pasteur considers the yeast of beer an organized body; he regards the modifications which it undergoes during alcoholic fermentation as of a nature essentially vital, and he shows that the chemical phenomena of fermentation are connected with a perpetual renewal of the yeast; whence it follows that, during the alcoholic fermentation, the sugar not only gives origin to chemical substances which disengage themselves or remain dissolved in the liquid, but at the same time, there is still a portion of the sugar which is taken up by the yeast in the form of cellulose, and another portion in the form of fatty matter, while the nitrogen of the old yeast serves to regenerate the new. Pasteur has made in this respect an experiment which, so to speak, reduces physiological conditions to the most simple relations which can connect living beings with mineral nature. He has shown, in fact, that the globules of yeast develop and multiply, and that the sugar ferments, when a quantity of the globules, so to speak, imponderable is sown in a medium composed at the same time of: 1st. A solution of pure candied sugar. 2d. An ammoniacal salt, the dextrotartrate, for example. 3d. Mineral substances containing phosphates. The ammonia is seen to disappear and to be transformed into the complex albuminous matter of the yeast, while at the same time, the phosphates give up their mineral constituents to new globules. The carbon which is one of the constituent elements of the yeast, is evidently furnished by the sugar. Before Pasteur, the lactic yeast was generally considered as organic matter in process of alteration, but not as organized matter. Our author has discovered and pointed out the special character of a lactic yeast, which is much more minute than the yeast of beer. During the lactic fermentation this yeast buds and multiplies, behaving in the matter of reproduction very much like the yeast of beer. In regard to the fermentation of tartaric acid and its congeners, Pasteur has arrived at very unexpected results, having a high chemical and physiological interest. Putting into conditions of fermentation with albuminous matter, and at a suitable degree of heat, the racemate of ammonia, which is formed by the union of the right- and left-handed tartrates of ammonia, and which has no effect on polarized light, it was seen that the phenomena of fermentation finally manifested themselves, and that new chemical products were formed at the expense of the racemate of ammonia. But it is remarkable that only the elements of the *right*-handed tartrate separate or ferment, to give rise to the products of fermentation, while under the same conditions the *left*-handed tartrate remains unaltered in solution in the liquid, which then acts very energetically upon polarized light. In this fermentation there is produced a yeast peculiar to the right-handed tartaric acid, which developes itself in presenting the characteristics of a mycodermic vegetable.

This example proves, in the plainest manner, the influence of the molecular dissimilarity of organic bodies, in the phenomena of fermentation. It is, indeed, impossible otherwise to interpret the marked differ-

ence which, in this respect, the right and left tartaric acids exhibit, since both have exactly the same physical properties, the same chemical composition, and they differ only in the interior arrangement, which gives to their constituent parts a rotatory power equal, but in opposite directions, and which corresponds to the dissimilarity which is reproduced in their aptitude or inaptitude, to be influenced by ferments.

In short, Pasteur regards the chemical phenomena of fermentation as being always correlative to the vital phenomena of organization, and to the development which takes place, at the same time, in the organized yeasts which have the power to excite it.

The committee judged that the author, in thus pursuing the physiologic study of the yeasts, in the direction which he had chosen, would bring new light to bear upon a series of organic products, which are related to the phenomena of nutrition and histogeny.

Transplantation of the Periosteum.—Honorable mention was also made of Mr. Ollier, in reference to his interesting experiments on the transplantation of the periosteum, preserving its property of renewing the osseous tissue. The author showed, that if a strip of the periosteum is detached from the bone of a living animal, and is transplanted to the subcutaneous cellular tissue upon the same animal, or upon another individual of the same species, the fragment of periosteum becomes encrusted, and continues to live in such a manner that vessels are formed in its substance, and communicate with those in its vicinity, as can be proved by careful injection after death: Ollier has likewise proved that, several hours after death, the possibility of this transplantation of the periosteum still remains.

Prize relative to the unhealthy Arts.—This prize was awarded to the inventor of a lamp suitable for giving light to laborers at work beneath the surface of water. It is a lantern, consisting of a thick cylindrical covering of glass fixed between two iron plates. A reservoir, containing a mixture of alcohol and turpentine ("burning fluid") is placed in the interior. Where the apparatus is plunged into water, the air necessary to support combustion comes to the bottom of the lantern through two iron tubes opening up into the atmosphere. The products of combustion are likewise removed by means of a tube fitted to the centre of the upper plate, which is also prolonged so as to open into the atmosphere, and of which the section is double that of both the tubes, through which the external air is supplied.

The inventor of this apparatus was a simple workman, named Guigardot. With this lamp it is possible to work under water to the depth of twenty metres. It has been used with success at the works of the monumental bridge built over the Rhine, at Strasbourg. It illuminates a circle of $2^{m}\cdot 50$ radius, even in turbed water.

Medical Prize.—In the preceding years we gave much praise to the committee in charge of the medical prize. They sometimes expended even 90,000 francs in prizes of all kinds, awarded even to chemists whenever their labors were important to one of the branches of the healing art. This year the committee have been economical, one knows not why, inasmuch as important works are not wanting. They have awarded only honorable mention to physicians for the labors of their profession.

Prize for Organic Chemistry.—The opposite state of things appears in the department of chemistry, which for the first time has awarded a prize to living chemists. A sum of 6000 francs was divided between Messrs. Wurtz and Cahours; to Prof. Wurtz for his researches upon glycol and its derivatives, and upon the new bases containing oxygen recently discovered; to Prof. Cahours for his labors in reference to the organic radicals. Be it understood, there is no question as to who is the discoverer of the composite radicals (Liebig), nor of the organo-metallic radicals (Lœwig).

Bréant Prize.—This prize is in reference to cholera and contagious diseases. It has not been awarded. The pieces sent for this *concours* were mostly mere letters, containing medical formulæ, all, according to their authors, infallible for the cure of the cholera, and all wanting, both in practical observations in regard to this dangerous disease, and in rational deductions as to the nature of its attack, and the symptoms which accompany and constitute it. The following are the principal questions proposed for the *concours* of 1861 and 1862:—

1st question. "Discuss carefully and compare with theory, the observations upon the tides, made in the principal ports of France."

2nd quest. "To complete in some important point the geometrical theory of polyhedrons."

3rd quest. "Establish the general equations of the movement of the earth's atmosphere, taking into consideration the rotation of the earth, the calorific action of the sun, and the attractive forces of the sun and moon."

4th quest. "Study of any question, at the option of the candidates, relative to optical phenomena."

5th quest. "At different points of the thermo-electric scale and for a difference of temperature reduced to 1° C. to determine the directions and compare the relative intensities of the electric currents produced by different thermo-electric substances."

6th quest. "Determine by experiment the causes which influence the difference of position of the optical and photogenic foci."

7th quest. "Comparative anatomy of the nervous system of fishes."

8th quest. "Study of the hybrid vegetables, with respect to their fecundity, and the perpetuity or non-perpetuity of their character."

9th quest. "Study of the mode of formation and of the structure of spores and of the other organs which contribute to the reproduction of fungi, their physiological office, the germination of the spores, and particularly with reference to parasitic fungi, their mode of penetration and developement in other living organized bodies."

Each of these prizes consists of a medal of the value of 3000 fr.

10th quest. "Essay upon carefully made experiments, to throw new light upon the question of so-called spontaneous generation."

11th quest. "Experimental study of the modifications which can be effected in the developement of the embryo of a vertebrate animal by the action of external agents."

12th quest. "Study of the distribution of the vessels of the latex in the different organs of plants, with particular regard to their relation to or connection with the lymphatic or spiral vessels, as well as with the fibres of the liber."

13th quest. "Determine experimentally what influence insects may exercise upon the production of the diseases of plants."

Each of these prizes consists of a medal of the value of 2500 fr.

Besides these prizes there are others: especially the Bréant prize (100,000 fr.) is to be awarded "to the person who shall have discovered the means of curing the Asiatic cholera, or shall have discovered the causes of this terrible scourge."

Now that we are upon the subject of prizes we will also say that a prize of 6000 fr. is offered by the society of Pharmacy at Paris, for "the question of the artificial production of quinine, or in default of this, of a substitute possessing equivalent anti-febrile properties." The prize for artificial quinine has been open since 1849.

Time strictly limited to July, 1861.

These concours are open to all scientists without distinction of country.

Obituary. Death of Poinsot.—This illustrious geometer died on the 10th of December last, at the age of 83 years. Born in 1777, he carried on his studies at the Polytechnic School from which he went out in 1796 in the character of an engineer of bridges and highways. He was successively, Professor at a Lyceum in Paris, and member of the higher council of public instruction. He had been a member of the Institute since 1813 where he took the place of the mathematician Lagrange. We shall speak no further of the titles, the dignities, and the decorations of Poinsot, since all these objects of human pride are but a vapor, and have added nothing to his merits, whom mechanicians place, in the history of mechanics, immediately after Archimedes, Galileo, Huygens and Newton. His principal claim upon the memory of posterity is founded upon "*La Statique*," the "*Memoire sur l'équilibre et le mouvement des systèmes*, 1806," and the *Théorie nouvelle de la rotation* and the *Mémoire sur les cônes circulaires roulants;* the last memoirs were in 1853.

In the *Elémens de Statique*, he brought to light his beautiful theory of couples and its application to the conditions of the equilibrium of machines.

Poinsot had a truly philosophic mind; he knew how to render the most abstract matter accessible and to bring it down to the most elementary ideas; this power was one of the characteristic traits of his genius. It is equally recognized in his work upon the precession of the equinoxes, that remarkable phenomenon discovered by Hipparchus, and explained two thousand years afterwards by d'Alembert.

Poinsot retained his intellectual activity to the close of his life. He never experienced the trials which are often met by men of science in their pathway. While yet young he saw the most illustrious judges proclaim his rare talents, and his life has always been happy and honored; Poinsot was not only a great savant, but moreover a good man.

Discovery of an Intra-Mercurial Planet.—The year 1860 has been inaugurated in France by an astronomical discovery, all the more remarkable because made in unusual circumstances. It is the discovery of another planet between the earth and the sun, verifying the conclusion to which Leverrier had arrived by the power of computation, that there existed one or more planets within the orbit of Mercury. This conclusion was announced to the Academy at the session of September 12,

1859, in a letter from Leverrier to Mr. Faye. Very soon reports were spread that the discovery of such a planet was no new thing. Among these reports, the most persistent was this, that such a planet had been observed towards the commencement of the year 1859, by an amateur astronomer, a poor country doctor. Leverrier, resolving to trace this story to its source, went personally to Orgères, a village in the Department of Eure and Loir, where this doctor resided. Great was the emotion of Dr. Lescarbault on seeing before him the illustrious director of the Observatory of Paris. He had little difficulty in satisfying Leverrier that the observation had really been made. He said, "On the 26th of March last, (1859), about four o'clock, in pursuance of my regular habit, I was exploring the sun's disc with my telescope, when suddenly I noticed near the border a small, well defined, round black spot, having a sensible motion. It advanced farther and farther on the sun's disc. Unfortunately just then occurred a call from a patient. I went down below, gave my advice to the patient, reascended to my observatory, the black spot continued its journey, and I saw it reach the opposite border of the sun and disappear, after being about an hour and a half on the disc."

The measurements made by Dr. L., with very simple means of his own, enabled Leverrier to determine that the chord of the sun's disc traversed by the planet was $9'\ 17''$; and it would have required $4^h\ 26^m\ 48^s$ to traverse the diameter of the sun. He estimates the angular diameter of the planet at about a quarter that of the planet Mercury when in transit. If this estimate is correct, the new planet is insufficient to account for the anomaly in the motion of the perihelion of Mercury; and there probably is, as M. Leverrier announced, a group of small planets between Mercury and the sun. Observers should give special attention to this subject at the next total solar eclipse.

The new planet has not been officially named, but it is already designated as *Vulcan*. Its return is looked for at Paris at the end of March or the beginning of April.

This discovery was not a matter of mere chance. Dr. Lescarbault, having observed the transit of Mercury, on the 8th of May, 1845, conceived the idea that if there were between the earth and the sun any planetary body besides Venus and Mercury, it must also sometimes cross the sun; and that by frequently observing its disc, such body might be detected thereon as a black point.*

Without fortune and without means of observation, Dr. Lescarbault was unable to obtain a telescope until 1853; and it was not until 1858 that he commenced systematic work. He made most of his auxiliary apparatus for himself, and went to work in astronomy very much as Scheele did in chemistry.

* In 1836 and 1837, M. Pastorff of Buchholz observed, several times, a pair of small, round black spots, of unequal size, passing, in a few hours, across the sun's disc, and each time in a different path. These must have been a planet with a satellite. Messrs. E. C. Herrick and Francis Bradley of New Haven, in 1847, endeavored to re-discover those bodies, by observing the sun's disc, twice a day, with a large telescope, and by exploring the vicinity of the sun with the telescope, armed in front with a pasteboard tube, blackened within. These efforts proved unsuccessful. (See this Journal, Nov. 1859, vol. xxviii, pp. 445–6.) The hypothesis of an intra-mercurial planet was also proposed, many years since, by M. Buys-Ballot, in his researches on a maximum and minimum of the solar heat.

M. Leverrier further informs us that the explanations which M. Lescarbault gave him entirely satisfied him that the alleged observations were real, and are entitled to a place in science; that the long delay in making them public is due solely to the modest reserve of the observer, and the quietude of a residence remote from the excitement of great cities. In support of his assertions, M. Leverrier has exhibited the proofs which he found in the domicil of Dr. Lescarbault, viz. a paper on which the latter had marked, on the 26th of March, 1859, the appearance of the black point on the solar disc, and a pine board on which Dr. L. had chalked his computations and his drawings.

Hardly had these announcements been made, when several other similar observations were called to mind. Mr. Scott, Chamberlain of London, writes in Galignani's Messenger of January 14, 1860, that an Englishman, Mr. Lloft, observed, January 6, 1818, a black point traversing the sun's disc, and that he (Mr. S.) had made a like observation in the summer of 1847, had thence concluded the existence of a third inferior planet, and had so published. His son, five years old, standing by, was placed at the telescope, and confirmed the observation by crying out, "I see a little balloon on the sun."

M. Wolff of Zurich has published several ancient observations, which he thinks refers to the transit across the sun of an intra-mercurial planet, viz. by (1,) Scheutzer of Crefeld, June 6, 1761; (2,) Staudacher, towards the end of February, 1762; (3,) Lichtenberg, November 19, 1762; (4,) Hoffmann, at the beginning of May. 1764; (5) Dangos, January 18, 1798; (6,)Fritsch, October 10, 1801; (7,) Stark, October 9, 1819. All these observers saw a round well-defined point, of the apparent diameter of Mercury, crossing the solar disc in a short period, varying from two to three hours. Using only the observations 5, 6 and 7, Mr. Wolff finds that they accord with the supposition of a planet having a revolution around the sun in 19·25 days, a result surprisingly near to that (19·7 days) deduced by M. Leverrier, from the observation of Dr. Lescarbault.

In settling the question, who is entitled to the credit of the discovery, it is clear that Dr. Lescarbault's observations are the first which have the scientific seal, and are of such a nature as to be subject of computation.

New Members Elected.—

Fizeau was elected 2nd of January member of the section of Physics in place of *Cagniard de Latour*—deceased.

Plana was elected March 5, foreign associate in place of *Lejeune-Dirichlet* deceased.

At the session of the *Académie* held March 19, Mr. J. A. Serret was elected a member in the section of Geometry in place of *Poinsot*, deceased.

Dausey has lately (March 12) communicated to the Academy a memoir, setting forth the geographical and physical observations of Hommaire de Hell made in 1846–48 in Turkey and Persia, where he died at Ispahan in August, 1848. His manuscripts were taken to France by Jules Laurent the well-known artist who accompanied the expedition. Dausey reports the barometric and astronomical determinations of much value.

Hypnotism and Magnetism.—French society has been almost carried away with a kind of scientific epidemic which may be compared to the

malady called "table tipping," which was so much in vogue a few years since. This epidemic is Hypnotism or nervous sleep. It was brought into notice by a French surgeon following a work of Dr. Braid (published 15 years since), in which this physician, describes under the name of Hypnotism, the nervous affection which is produced under the following circumstances:—When a brilliant object is placed directly before the face at a distance of from 8 to 15 inches, and the subject of the experiment is requested to fix his eyes steadily upon the object, in such a way as to produce a permanent contraction of the muscles of the eye and eyelid, there will be seen to come on, after the lapse of a few minutes, a state analogous to catalepsy. M. Broca, having successfully employed hypnotism in producing insensibility to pain, proposes it to surgeons as an anæsthetic agent capable, in many cases of being substituted in practice for ether or chloroform, "because," as he remarks to physicians, "this method, introducing as it does no substance into the system, appears to me absolutely harmless."

From the numerous experiments which have since been made, it results; 1st, that this kind of anæsthesia can be developed but rarely, and in persons whose nervous system is especially predisposed; 2nd, that hypnotism may give rise to attacks of epilepsy.

This kind of anæsthesia is therefore not less open to objection than the other. Its origin is more ancient than is supposed; it was established more than two centuries ago, under the name of *irradiation* or *phenomena of actinobolism*, by P. Kircher in his *Ars magna Lucis et Umbræ*.

It is concluded that in hypnotism is seen only a fact in the domain of animal magnetism, which is not yet a science. We will not enter further into the details.

Porous bodies.—Among the topics of scientific interest which awaken attention at present, is the research of Jamin, professor at the École Polytechnique, upon the equilibrium and movement of fluids in porous bodies. The new results at which he has arrived afford an explanation of the ascent of the sap in vegetables without the necessity of recourse to the vital force. It is apparently a question of capillarity only.

Jamin has applied the new facts which he has discovered to the construction of an apparatus composed entirely of inorganic materials, but showing in its structure a great analogy with vegetables. This apparatus has the property of raising water as trees do, to a height greater than that attained by means of atmospheric pressure, from a moist soil whence the water is constantly drawn to the factitious leaves where it is continually evaporated.

Reduced to its most simple form this apparatus is composed of a block of some well dried porous substance as chalk, lithographic stone, &c., or a porous battery cell filled with a powder well rammed in, white chalk for instance, oxyd of zinc, or even with earth. A manometer is imbedded in the interior of the mass, and the whole is plunged in a vessel full of water. The water immediately penetrates its pores and drives out the air, which collecting in the interior, exercises a pressure upon the manometer amounting with oxyd of zinc to *five* atmospheres and with starch it exceeds *six* atmospheres. This is not the limit of the greatest possible pressure; Jamin makes known the causes which diminish it in these cases and proves that the water is forced into porous bodies with a force which he calls π, and which is equal to that of a considerable number of atmospheres.

A tube 1·20 metres long filled with plaster and terminated at the summit by an evaporating surface is inserted by its base into a reservoir closed and filled with water; a vacuum is caused measured by 15 or 20 millimetres of mercury or by 200 or 270 millimetres of water; and the water appears even at the upper extremity of the tube, which proves *that porous bodies are able to raise water higher than can be done by atmospheric pressure.* These facts cannot be explained by the ordinary laws of capillary attraction, since these bodies are not formed of impermeable tubes, but of corpuscles in juxtaposition, separated by small empty spaces. Jamin has therefore submitted the problem to the calculus and has come to results, of which we mention the following:

If in a damp porous body, the water is compressed by a power of several atmospheres, it can congeal only at a temperature below 0° C.* Consequently the old wood is able to resist frost, while the young shoots being less dense are unable to do so.

Since water in filtering through a porous body is compressed as it enters and dilates again as it runs out, it should exhibit electric currents and many other phenomena.

The theory can not be applied to non-homogeneous porous bodies. In the extended memoir which he has prepared, Jamin discusses the complicated results which may be occasioned by irregularity of structure; he makes an application of it to wood, and shows that the interior pressure must be augmented in the denser tissues; that the air must come from the larger tubes, which cannot serve for the ascent of the sap.

It is plain that the evident tendency of all these experiments is to explain the ascent of the sap in vegetables by capillarity. The idea is not new, but it has not been hitherto fully admitted, notwithstanding the experiments which have been heretofore made.

Jamin gives it probability in showing by decisive experiments, that porous bodies exercise a capillary action superior to the pressure of the atmosphere; further, he gives the physical theory of capillarity in porous bodies and succeeds in calculating the phenomena of the movement of liquids in trees. This is thoroughly physiological. If the Academy of Sciences could award the great prize for physiology, for a work upon fermentation, when it is not yet known whether this purely chemical phenomena is the result of vital action as Cagniard de Latour maintains, or the manifestation of a mechanical effect as Liebig explains it, in his beautiful theory of fermentations,—if this work in chemistry deserved the great prize for experimental physiology for a stronger reason should they award this prize for the splendid physical researches of which we have just spoken.

Application of electric light in Medicine.—The ordinary processes of illumination are of very difficult application when the object is to employ artificial light in diagnoses or in certain cases in operative medicine, inasmuch as the illumination is insufficient, or the light is more or less colored, and is accompanied with heat. It is not the ordinary electric light here spoken of, but that produced by induced currents. The problem to be solved consists in finding a source of light with little or no heating effect, which can be compressed into tubes of small capacity and of forms adapted

* This fact has just been demonstrated by Mr. Sorby for water contained in capillary tubes of a small diameter.—J. H.

to circumstances, and which finally is of such whiteness as not visibly to alter the color of organic tissues illuminated by it. This problem has just been solved by Dr. Fonssagrive, physician of the naval school at Brest, with the coöperation of Messrs. Ruhmkorff and DuMoncel. The apparatus consists of an empty tube of Geissler, of very small diameter folded and turned upon itself after the manner of multipliers; this tube contains a gaseous mixture which gives a perfectly white light when it is traversed by an electric current produced by an induction coil.

Phosphorescence.—The electric lamp (*photophore*) of which we were just speaking calls to mind some observations upon phosphorescence which have just been made by Phipson; he has found that like cane sugar, the *sugar of milk* or *lactine* becomes luminous by concussion, and also by fracture. To evolve phosphorescence from the *nitrate of uranium*, it is sufficient to shake briskly a bottle containing a certain quantity of this salt in the crystalline state. The light is very vivid when the experiment is made with one or two kilograms of this substance. Calomel possesses the same property, although in a less degree.

Works of Arago.—The sixteenth and last volume of Arago's works has just appeared. It contains a great number of unpublished researches made by Arago during his career.

The sixteen triangles are here given which Messrs. Biot and Arago determined in the prolongation of the meridian of France to the island of Formentera. Arago alone, has measured besides, a seventeenth triangle having its summit at the enclosure of Galaro in the island of Majorca and resting in one direction upon Camprey in the island of Trizza, and the other upon the mole of Formentera, with the design of obtaining the length of an arc of the parallel nearly 3° from the extremity of the meridian, and to determine the curvature of that portion of the earth's surface. The results of these measurements, heretofore unpublished, are found in this volume.

Arago in the year 1853, the very year of his death, communicated to the Academy a memoir upon the figure and physical constitution of Mars, which is likewise contained in this volume, and is accompanied by more than 3000 micrometrical measurements of the diameters of Mars, Jupiter, Saturn and Uranus, which were taken from 1811–1847.

It is well known that Arago made numerous investigations in regard to the refractive power of atmospheric air, dry or humid, and of different gases and vapors. He labored in this department for nearly half a century, namely, in 1805 with Biot, in 1815 and 1816 with Petit, and in 1852 with Fizeau. Chemists and physicists will derive much advantage from the determination of the refractive powers not only of some simple gases, but also of compound gases such as oxyd of carbon, carburetted hydrogen, sulphuretted hydrogen, cyanogen, the vapors of sulphur and of carbon, of sulphuric ether and chlorohydric ether.

This volume also contains studies upon optics, atmospheric electricity, &c. United to the other fifteen volumes it forms a lofty monument to science as well as to one of its most noble representatives.

Bibliography.—The following works have just appeared at Paris.

Oeuvres d'Arago, Tom. xvi, 1859; chez Gide, 5 rue Bonaparte.—This volume is devoted to scientific notices bearing upon the personal labors of Arago, many of which have never before been published.

At the *Librarie centrale des sciences rue de Seine; Recherches sur le non-homogénéité de l'étincelle d'induction*, par M. Th. du Moncel, 1860.—M. du Moncel, who gives all his leisure to the study of electricity and its applications, presents in this brochure the result of his researches upon the electric spark, and especially the spark of induction, of which the non homogeneity was discovered by him in 1855.

At Baillière Bros., Paris & New York. *Traité élementaire de Physique expérimentale*, Tom. I. 12°, 1860. par M. Forthomme, professor of Physics at the Lyceum in Nancy.—This work, even by the confession of the author, contains nothing new, but is distinguished by its method. The most difficult questions in regard to gravity, hydrostatics and heat are explained in the first volume with great clearness, and thus rendered intelligible to persons little versed in these matters, which are so important in our day and have so many useful applications.

By *Lacroix & Baudry*, Quai Malaquais.—*Grands hommes et grandes choses, notices scientifiques sur les inventions et sur les decouvertes modernes et sur les auteurs, par Victor Meunier.* 8°, 1860—This work appears by numbers, once a week; its author, of whom we have often spoken, has acquired in France a great reputation as a popularizer. He established the *Ami des Sciences*, a journal for scientific discussions, which he has directed for six years, and is remarkable for the independence of his opinions and judgments. M. V. Meunier in this new publication proposes all the great scientific questions of the day.

Art. XXXVIII.—*Description of an Equatorial recently erected at Hopefield Observatory, Haddenham, Bucks;* by the Rev. W. R. Dawes.

(*From the Monthly Notices of the Royal Astronomical Society.*)

My observatory was furnished, in May last, with an equatorially-mounted telescope by Messrs. Alvan Clark and Sons, of Boston, U. S., which in several important points differs from any other in this country; and I therefore hope that a brief description of it may not prove uninteresting to the Royal Astronomical Society.

The form combines great firmness and compactness with considerable elegance of design. The massive part of its structure is of cast-iron, the base of which is firmly bolted down to a stone pier. The semicircular form of the upper part affords a secure position for most of the wheel-work of the driving-clock, of which the going-weight descends in a groove on the east side of the pier, and is not seen in the drawing. The space between the polar axis and the semicircular bed-piece is occupied at its lower part by the hour-circle. Immediately above this is a sector, which clamps on to the axis, and the wheel-work of the clock occupies the upper portion. The sector has a radius of rather more than 9 inches and an arc of 30°, or two hours of right ascension. This arc has a face of an inch and a half in breadth, between which and a cylinder 7 inches in circumference there is just room enough for two thin bands of sheet-brass, each of about three-fourths of an inch in width, to pass side by side. These bands are both keyed by the end into one groove in the cylinder, at such a distance that they cannot overlap or interfere with each other. They are then bent round the cylinder in

opposite directions, the end of one being fastened to one extremity of the arc of the sector, and the end of the other at the other extremity of the arc to a piece of brass which is acted upon by a screw and nut, for giving to both the bands a due degree of tension. The sector and cylinder thus move together without friction, irregularity, or lost time.

Upon the same arbor with the cylinder is the wheel, 15 inches in circumference, in the racked edge of which the driving-screw works. This arrangement gives the screw about the same driving-power as if it acted on the edge of a wheel nearly 40 inches in diameter, fixed on the polar axis.

I have every reason to be satisfied with the going of the driving-clock; and the cylindrical bob of the pendulum being screwed on to its steel rod, the rate is capable of adjustment to the greatest nicety. Great care has been bestowed by the makers upon the accurate dividing of the wheel-work; and I have much pleasure in acknowledging that its performance fully bears out my expectations, founded on the character given by the Messrs. Bond of the clock-work applied by the same makers to the great Munich equatorial in Harvard Observatory, which has been so successfully employed for the purposes of telescopic photography. While the speed of the clock is regulated by the vibrations of the half-seconds pendulum, the action of the pendulum on the wheel-work is rendered smooth and equable by an ingenious application of Bond's *Spring-governor;* and so perfectly successful is this contrivance, that with the thread of the micrometer bisecting a star, and a power of 800 or 1000 on the telescope, no interruption or jerk from the escapement is perceivable.

For producing a slow motion in right ascension, the driving-screw is mounted on a brass frame, which, being carried by a fine screw under the observer's control, acts as a slipping-piece through nearly five minutes of time.

A firm clamp, close to the cradle of the telescope, fixes the declination-axis, and is accessible to the observer both at the eye-end, and also during the setting of the declination-circle. A slow-motion screw acts on an arm extending from the clamp to the bottom of the cradle to which the screw is attached.

To permit the adjustment of the polar-axis to the latitude and meridian of the place, the upper part of the cast-iron bed-piece is made with a groove which receives loosely a projecting keel on the portion bolted down to the pier. The form both of the groove and of the keel being semicircular, the upper portion is moved upon the lower by the stout screw which is seen in the drawing, and the polar-axis is thus easily raised to the required angle. The adjustment to the meridian is performed by the screws on each side of the groove in the upper piece pressing

against the keel in the lower, which has play enough in the groove to allow of a moderate degree of azimuthal motion.

To facilitate the finding of objects in Mr. Clark's "Two-eye-piece Micrometer," when their distance exceeds the field of one of the eye-lenses, the finder is furnished at its eye-end with a small position-circle divided into degrees. The thick wires of the finder being placed in the direction of the objects to be measured, the reading of the position-circle indicates the approximate setting for the micrometer, whereby the two objects may be immediately found by their respective eye-lenses. The aperture of the finder being two inches, it will show a star of the $9\frac{3}{4}$ magnitude of Struve's scale.

The object-glass of the telescope has a clear aperture of $8\frac{1}{4}$ inches, and a focal length of about 110 inches. The materials were furnished by Chance and Co., of Birmingham. The figure is excellent to the circumference, and the dispersion but little over-corrected. Its performance fully supports the character of Mr. Alvan Clark's object-glasses, and I believe it to be capable of everything which can be performed by such an aperture. It clearly divides γ^2 *Andromedæ*, and shows the smallest companions among the stars of the Pulkova Catalogue.

Haddenham, near Thame, November, 1859.

SCIENTIFIC INTELLIGENCE.

I. CHEMISTRY AND PHYSICS.

1. *On Fraunhofer's Lines.*—KIRCHHOFF has communicated a preliminary notice of very remarkable investigations on the spectra of colored flames. These investigations have given an unexpected clue to the origin of Fraunhofer's lines, and justify some remarkable conclusions as to the constitution of the atmosphere of the sun and perhaps also of the more brilliant fixed stars.

Fraunhofer remarked that in the spectrum of the flame of a candle there are two bright lines which correspond with the two dark lines D of the solar spectrum. The same bright lines are obtained more easily and stronger from a flame into which common salt has been introduced. The author produced a solar spectrum and allowed the sun's rays before they fell upon the slit to pass through a powerful salt flame. When the sunlight was sufficiently weakened two bright lines appeared instead of the two dark lines D; when however the intensity of the sunlight exceeded a certain limit, the two dark lines D were seen with much greater distinctness than without the presence of the salt flame.

The spectrum of Drummond's light usually contains the two bright sodium lines, when the luminous portion of the lime cylinder has not been exposed to ignition for a long time; if the lime cylinder remains fixed, the lines become weaker and finally vanish. Under these circumstances, a

salted alcohol flame placed between the lime cylinder and the slit, produces two dark lines of extraordinary sharpness and fineness, which exactly correspond to the lines D of the solar spectrum. In this manner these lines are artificially produced in a spectrum in which they do not actually occur.

If we introduce chlorid of lithium into the flame of Bunsen's gas lamp, the spectrum exhibits a very bright, sharply defined line, which lies in the middle between Fraunhofer's lines B and C. If we allow solar rays of moderate intensity to pass through the flame to the slit, we see the line bright upon a dark ground; but with a greater intensity of the sunlight a dark line occupies its place, which has precisely the character of Fraunhofer's lines. When the flame is removed, the line vanishes completely.

The author concludes from these observations that colored flames in whose spectra bright sharp lines occur, diminish the intensity of rays of the color of these lines, when these pass through them, to such a degree, that in place of the bright lines, dark ones occur, whenever a source of light of sufficient intensity is placed behind the flame. He further concludes that the dark lines of the solar spectrum which are not produced by the earth's atmosphere result from the presence in the ignited sun's atmosphere of those substances which produce in the spectrum of a flame bright lines in the same place.

We may assume that the bright lines corresponding with D in the spectrum of a flame always arise from the presence of sodium; the dark lines D in the solar spectrum allow us therefore to conclude that sodium is present in the sun's atmosphere. Brewster has found in the spectrum of the flame of saltpetre bright lines in the position of Fraunhofer's lines A, *a*, B; these lines indicate the presence of potassium in the sun's atmosphere. From the author's observation that no dark line in the solar spectrum corresponds to the red lithium line, it would follow that lithium is either not present at all in the sun's atmosphere or is present only in very small quantity.

The investigation of the spectra of colored flames has in this way obtained a new and high degree of interest. The author promises to pursue the subject in connection with Bunsen, and states that they have already obtained results which render it possible to determine the qualitative constitution of complicated mixtures from the appearance of the spectrum of their blowpipe flames. In pursuing together the investigation of Kirchhoff's discovery of the influence of flames upon rays of light, a remarkable fact has appeared which promises to be of great importance. Drummond's light requires a salt-flame of low temperature in order that the lines D may appear dark. The flame of alcohol and water is adapted to this purpose, but the flame of Bunsen's gas lamp is not. In this last case, the smallest perceptible quantity of salt causes the bright lines to appear. The authors reserve the developement of the consequences of this remarkable fact.—*Pogg. Ann.*, cix, p. 148, *January*, 1860.

Note.—Professor Stokes, in a letter to the editors of the L. and E. Phil. Mag. directs attention to the fact that Foucault, in 1849, published a short paper in l'Institut containing observations exactly analogous to those of Kirchhoff. Foucault's experiments were made by transmitting solar light through the galvanic arc, and appear to have escaped attention until their second and independent discovery by Kirchhoff.

2. *On the direct conversion of lactic into propionic acid.*—The conversion of lactic into propionic acid was first observed by Ulrich who obtained chloropropionic acid by distilling lactic acid with perchlorid of phosphorus. Lautemann has succeeded in a more direct transformation of lactic acid by the agency of iodid of hydrogen. When concentrated lactic acid is diluted with half its volume of water and the cooled liquid is saturated with iodohydric acid gas, iodine is set free and if the liquid is heated in a closed tube to 140° C. iodine is separated in quantity. The filtered liquid neutralized with potash and then distilled with dilute sulphuric acid yields propionic acid mixed with some iodine and iodohydric acid which are easily separated by carbonate of silver. The reaction which yields propionic acid is expressed by the equation

$$\underset{\text{Lactic acid.}}{C_6H_5(HO_2)O_4} + 2HI = \underset{\text{Propionic acid.}}{C_6H_6O_4} + 2HO + I.$$

The same result may be still more easily obtained by distilling lactic acid with biniodid of phosphorus when propionic acid passes over colored by free iodine. Lautemann considers these results as confirming Kolbe's view that lactic acid is propionic acid in which one equivalent of hydrogen is replaced by one of the compound radical HO_2.—*Ann. der Chem. und Pharm.*, cxiii, 217.

3. *On the Formation of Alanin from Lactic Acid.*— STRECKER's discovery that alanin may be converted into lactic acid by the action of nitrous acid is familiar to chemists. Kolbe has succeeded in effecting the reverse process, that is, in obtaining alanin from lactic acid. Lactate of lime is to be converted into chlorid of propionyl by distillation with perchlorid of phosphorus and this by treatment with absolute alcohol into chloropropionic ether. The ether is then to be treated with a concentrated solution of ammonia in a closed tube for several hours. The solution on evaporation gives a mixture of sal-ammoniac and alanin which are easily separated. The reaction in this case is expressed by the equation—

$$C_6H_4ClO_3, C_4H_5O + 2NH_3 + 2HO = C_6H_4(NH_2)O_3, HO + NH_4Cl + C_4H_5O, HO.$$

Ann. der Chem. u. Pharm., cxiii, 220.

4. *On the Constitution of Lactic Acid*—KOLBE has communicated a very interesting discussion of this subject, maintaining his view that lactic acid is monobasic and is to be regarded as oxypropionic acid. We must however refer to the original paper which does not admit of condensation.—*Ann. der Chem. und Pharm.*, cxiii, 223.

5 *Contributions to the Chemistry of the Platinum-metals.*—CLAUS has continued his investigations of this most difficult subject and has obtained many new and interesting results, the most important of which we shall here state.

In the present paper, the author confines his attention chiefly to ruthenium and its analogies with osmium. The hydrated deutoxyd of ruthenium has the formula $RuO_2 + 5HO$ and may be obtained either by digesting the corresponding chlorid with carbonate of potash and washing the oxyd with boiling water, or by precipitating the sulphate of the oxyd with potash or soda. The sulphate in question may be prepared by oxydizing the sulphid with nitric acid. The oxyd when freshly precipi-

tated is a slimy ochre-colored substance which dries to a rust colored mass resembling hydrated sesquioxyd of iron. It dissolves in acids with a bright yellow color, and gives on heating with chlorhydric acid, a beautiful red solution of the chlorid. When heated to 300 C. the oxyd loses a portion of its water, and when more strongly heated, explodes in consequence of the instantaneous separation of the remaining water.

The author describes in full the double salts $RuCl_2$, KCl and $RuCl_2$, NH_4Cl and gives their reactions with the usual reagents. Ruthenium forms, like osmium, an acid containing four equivalents of oxygen, as well as the ruthenic acid RuO_3 already described by Claus. To this acid Claus gives the name of hyper-ruthenic acid; it may be prepared by passing a current of chlorine into an alkaline solution of ruthenic acid, prepared by fusing metallic ruthenium with caustic potash and saltpetre.

The hyper-ruthenic acid, being volatile, distils over, and may be collected in a receiver. The new acid is a golden yellow crystalline and volatile substance. On gentle heating, it melts into golden yellow drops, which again solidify as a crystalline mass. The acid is very volatile and evaporates at ordinary temperatures; its gas has a golden yellow color, and the acid has a peculiar smell which resembles that of nitrous acid. The gas irritates the lungs and produces a cough, but does not attack the eyes like osmic acid. It has little taste, but is somewhat astringent, though not acid. Its boiling point lies not far above 100° C.

The acid is very easily reduced. In the moist state its solution is decomposed after a few hours, with formation of the sesquioxyd. Alcohol and the greater number of organic bodies easily reduce it. Potash dissolves the acid slowly, but the solution passes after a time into one of ruthenate of potash. The author gives the relations of this body to other reagents in detail, but for these we must refer to the original memoir.

When a solution of $RuCl_2$, NH_4Cl is evaporated to dryness with an excess of ammonia, the chlorid of a new base is formed, the formula of which, according to Claus, is $2NH_3 . RuCl + 3HO$. The salt has an Isabel yellow color, and crystallizes in rhombic tables, which are soluble in water and yield on heating pure metallic ruthenium. When this chlorid is digested with an excess of freshly prepared oxyd of silver, it yields a solution of the oxyd. On evaporation, this solution gives a rather porous, yellow, crystalline mass; this base appears to be even more caustic than caustic potash itself. The author promises a more complete description of this interesting base, as well as additional contributions to the chemical history of iridium and rhodium.—*Journal für prakt. Chemie.* vol. lxxix, 28, *January 31st.*

6. *Synthesis of new Bases containing Oxygen.*—Wurtz has observed the remarkable and important fact that oxyd of ethylene $C_4H_4O_2$ combines directly with ammonia, forming very well defined and powerful bases. When concentrated aqueous ammonia is mixed with oxyd of ethylene and the mixture is allowed to stand, combination ensues with a strong evolution of heat. On evaporation an alkaline syrup is obtained which gives with chlorohydric acid a solution from which colorless rhombohedra separate. These have the formula $C_{12}H_{15}NO_6 + HCl$: the platinum salt is $C_{12}H_{15}NO_6, HCl + PtCl_2$. The mother liquor of these rhombohedra contains another chlorid, the platinum salt of which has the formula—

$C_8H_{11}NO_4$, $HCl+PtCl_2$. The formation of these bases is indicated by the equations—

$$3C_4H_4O_2+NH_3=(C_4H_4O_2)_3H_3N=C_{12}H_{15}NO_6$$
$$2C_4H_4O_2+NH_3=(C_4H_4O_2)_2H_3N=C_8H_{11}NO_4.$$

These results may perhaps lead to the discovery of the true constitution of the complex organic alkaloids containing oxygen. They appear to show that Berzelius' view that the alkaloids are conjugates of ammonia may be true in some cases at least.—*Comptes Rendus*, xlix, 898.

7. *On a new series of Alcohols.*—Wurtz has also found that oxyd of ethylene unites with water to form new alcohols which he terms diethylene and triethylene alcohols. The reactions involved are represented simply by the equations—

$$C_4H_4O_2+2HO=C_4H_6O_4. \quad \text{Glycol.}$$
$$C_4H_4O_2+2HO=C_8H_{10}O_6. \quad \text{Diethylene-alcohol.}$$
$$3C_4H_4O_2+2HO=C_{12}H_{14}O_8. \quad \text{Triethylene-alcohol.}$$

Oxyd of ethylene also unites directly with glycol so as to form the diethylene and triethylene alcohols. The equations are

$$2C_4H_4O_2+C_4H_6O_4=C_{12}H_{14}O_8.$$
$$C_4H_4O_2+C_4H_6O_4=C_8H_{10}O_6.$$

All these substances behave like alcohols. The diethylene alcohol was also discovered by Lourenço and called by him the intermediate ether of glycol.—*Comptes Rendus*, xlix, 813.

8. *Researches on the Platinum metals;* from a letter of Dr. Wolcott Gibbs to one of the editors.—"The completion of my researches on the platinum metals has been delayed much longer than I expected. This has arisen partly from the intrinsic difficulty of the subject and partly from its expansion in particular directions in a very unexpected manner. A brief sketch of the results already obtained—imperfect as they are—may perhaps interest you.

The osmium-base of which Dr. Genth and myself published a brief notice about two years since in the Journal, proves to be the type of a very extensive series of compounds which promise to be of much theoretic interest. You will remember that the chlorid of that base is produced when osmite of potash, KO, OsO_3, is added to a solution of sal-ammoniac. I now find that new complex bases are formed when the osmite is added to solutions of the chlorids of narcotin-ammonium, cinchonin-ammonium, &c., &c.; in short, almost all the complex alkaloids which I have yet tried give analogous bases containing osmium in the radical. The new bases are very easily decomposed with evolution of osmic acid. They are more stable in the presence of an excess of chlorhydric acid and give crystalline double salts with the chlorids of gold and platinum.

These however are not the only or even the most remarkable basic compounds which I have discovered. Many of the ammonia-metal bases already described are capable of forming new bases into which osmium enters either as a conjugate body or as replacing hydrogen. When, for instance, osmite of potash is added to a solution of the chlorid of pallad-diamin, $2NH_3.PdCl$, a yellowish brown solution is formed

which on addition of chlorhydric acid gives a beautiful yellow crystalline precipitate insoluble in cold water and containing palladium, osmium and the elements of ammonia.

When osmite of potash is added to a solution of chlorid or sulphate of luteocobalt, $6NH_3 . Co_2Cl_3$ or $6NH_3 . Co_2O_3 . 3SO_3$, a buff-yellow precipitate is thrown down, which on addition of HCl gives a wine-yellow solution. This solution after a short time deposits beautiful crystals of the chlorid of a new base containing osmium, cobalt, and the elements of ammonia. The chlorid gives well crystallized salts with the chlorids of platinum, gold and mercury. Its solution is decomposed by gentle heating, osmic acid being evolved while a black powder is thrown down.

The other ammonia-cobalt bases give analogous compounds which however are decomposed almost as soon as formed. It is my intention if possible to examine the relations of osmite of potash to one or two of the arsenic and antimony bases, as for example to the chlorids having the formulas $(C_4H_5)_4AsCl$ and $(C_4H_5)_4SbCl$.

When ammonia is added to a solution of osmite of potash, the red color of the latter passes immediately to wine-yellow. Fremy supposes that an osmiamid is formed here having the formula $OsO_2 . H_2N$. I find that the product is a new osmium base, the chlorid of which is formed at once by neutralizing the yellow solution with HCl. This chlorid has probably the formula $\left.\begin{matrix} H_3 \\ Os \end{matrix}\right\} NCl$, though it may be $\left.\begin{matrix} H_3 \\ OsO_2 \end{matrix}\right\} NCl$. In like manner I am still doubtful whether the true formula of the other ammonia-osmium base is $2NH_3 . OsO_2 . O$ or $2NH_3 . OsO + 2HO$. Experiments now making will decide this point. Meantime I may say that I do not agree with Claus in considering the formula $2NH_3 . OsO_2 . O$ improbable since we have many analogous cases, as for instance in xanthocobalt and flavocobalt, the formulas of the chlorids of which are, you will remember,

$$NO_2 . 5NH_3 . Co_2O . Cl_2 \text{ and } 2NO_2 . 5NH_3 . Co_2O . Cl_2.$$

The chlorid $2NH_3 . OsO_2 . Cl$ or $2NH_3 . OsCl + 2HO$ is decomposed by boiling with chlorhydric acid, giving sal-ammoniac and a new chlorid which is perhaps identical with that just mentioned. This is easily explained by the equation

$$2NH_3 . OsCl + HCl = NH_3 . OsCl + NH_4Cl,$$

and the decomposition would then be exactly analogous to that of pallad-diamin under the same circumstances

$$2NH_3 . PdCl + HCl = NH_3 . PdCl + NH_4Cl.$$

I hope soon to decide these questions by experiment and analysis, but the analyses are very difficult and tedious, and I have to feel my way and find out new methods for almost every determination.

You will see from the above that osmium is likely to become one of the most interesting of the elements, and that it is capable of forming an extraordinary number and variety of compounds. I am also very busy with the remarkab e class of double nitrites which I described at the meeting of the Am. Association for the Advancement of Science in August last. There are still some difficulties to be overcome, but I am

confident that I shall be able to effect a perfect separation of all the metals of the platinum group. The white iridium salt appears to have the formula $Ir_2O_3.2NO_3+3KO.NO_3$, but it contains a small quantity of chlorine which may be essential. Its stability and insolubility are very remarkable, and will I think prove of great value in separating iridium from the other metals. The corresponding salts of the other metals of the group appear to be all soluble. The ruthenium salt is soluble even in alcohol and ether, and gives with sulphid of ammonium a magnificent red solution. This is by far the most delicate test for ruthenium yet discovered as the reaction is peculiar to that metal. Claus' beautiful reactions with sulphocyanid of potassium and sulphydric acid are much inferior for qualitative purposes."

New York, March 30, 1860.

TECHNICAL CHEMISTRY.

9. *Solution of Cellulose in Ammonio-oxyd of copper.*—Some time since ERDMANN, in his *Journal für praktische Chemie* (lxxvi, 386) expressed the opinion that cellulose is not really dissolved by cuprate of ammonia, as stated by SCHWEIZER (*ibid*, lxxii, 109), but only swollen to a sort of thin mucilage like the well known limpid "solution" of starch.

This view was based upon the fact that when a clear solution of cellulose in $NH_3\,CuO$ is diluted with a large excess of water, the cellulose separates entirely in the course of a few days.

In defense of his original statement Schweizer now urges that the cellulose must be really dissolved by ammonio-oxyd of copper: since its fibres are unquestionably destroyed when this reagent comes in contact with them—as may be distinctly seen with the microscope; and since the cellulose precipitated from a solution of cotton in the above mentioned reagent no longer exhibits any trace of definite structure.

A solution of cotton in $NH_3\,CuO$ may also be filtered perfectly clear—although this operation is somewhat difficult when large quantities of the liquid are operated upon. The solution is moreover capable of passing through the cell membranes of plants as shown by CRAMER (*ibid*, lxxiii, 6).

The destruction of the solvent power of the cuprate of ammonia by dilution appears to depend upon alterations which this compound itself undergoes under certain circumstances. It often happens that a solution of ammonio-oxyd of copper which at first dissolved cotton with the greatest ease gradually loses this power even when kept in carefully closed vessels completely filled with the liquid. It is moreover well known to chemists that solutions of ammonio-oxyd of copper, and of the ammonio-copper salts, undergo decomposition when diluted with large quantities of water;—hydrate of copper being precipitated.

This decomposing influence which water exerts upon solutions of the compound of ammonia and oxyd of copper is in the opinion of Schweizer the cause of the gradual precipitation of cellulose from such solutions when these are largely diluted.—*Journal für praktische Chemie*, lxxviii, 370; compare also CRAMER, *ibid*. lxxiii, 1, *et seq.*

10. *Decoloration of Indigo by Sesquioxyd of Iron.*—According to KUHLMANN, when a solution of blue indigo is acted upon at the temperature of 150° (C.) by hydrated oxyd of iron its color is, almost immediately, completely destroyed. The same thing occurs with a number of other coloring matters.—In noticing this fact BARRESWIL suggests that persul-

phate of iron may perhaps be applied in calico-printing as a discharge for indigo and also in bleaching blue rags for paper making.—*Répertoire de Chimie Appliquée*, Oct. 1859, p. 429.

[The observation that salts of the sesquioxyd of iron have the power of bleaching indigo and other organic coloring matters was first made by Prof. H. WURTZ of Washington and published two years since in this Journal (vols. xxv, 378, and xxvi, 52)—also in the Proc. of Amer. Assoc. 1858 and in several foreign journals—to him unquestionably belongs whatever credit may attach to the discovery—F. H. S.]

11. *Aluminum Leaf*—A Parisian gold beater, DEGOUSSE, has succeeded in obtaining leaves of aluminum as thin as those from gold and silver. The aluminum must be reheated repeatedly over a chafing dish during the process of beating. This leaf is less brilliant than that of silver but it is not so easily tarnished as the latter. It is easily combustible, taking fire when held in the flame of a candle and burning with an exceedingly intense white flame.

According to FABIAN, (Dingler's polyt. Journal, cliv, 438,) the chemical lecturer will find aluminum leaf to be well adapted, for exhibiting the characteristic properties of the metal. It dissolves, for example, with surprising rapidity in a solution of caustic alkali.

[A specimen of this leaf accompanies the description of it in *Répertoire de Chimie Appliquée*, Oct. 1859, p. 435, also Nov., p. 488.]

12. *Critical and Experimental Contribution to the Theory of Dyeing.*—Under this title a somewhat extended treatise by Prof. BOLLEY of Zurich has appeared in the L. E. and D. Philosophical Mag. [4] xviii, 481, Supplement to Dec. 1859.

Two questions have long been agitated among chemists interested in the theory of dyeing. (1.) In what part of the colored fibre is the coloring matter situated? Does it merely adhere to the surface, or does it penetrate the entire substance of the cell-walls of such fibres as cotton and flax? Or lastly, in the case of such fibres is it stored up in the interior of the cells? (2.) What is the nature of the union between the dye and the fibre? Is it a chemical combination, or is it due to mere surface attraction? After comparing the various theories which have been advanced during the last century and discussing the merits of each, the author records the results of his own experiments, from which it appears that wool and silk in all cases where they have not been dyed with colors in a mere state of suspension* seem to be impregnated with the dye throughout their entire mass; while in the case of cotton, by far the larger portion of the coloring matter adheres to the surface of the fibre, the penetration of the cell-walls by the dye being either very slight or altogether wanting.

That the theory of W. Crum (L. E. and D. Phil. Mag., April, 1844,—compare this Journal, [2], xxviii, 125), in accordance with which the tubular form of the cotton fibres is an essential condition to their taking a dye, is unfounded, appears from the fact that the amorphous cotton-gelatine precipitated from its solution in cuprate of ammonia (see this Journal [2], xxvii, 118) may be mordanted and dyed like ordinary cotton. In like

* In which case the coloring matter only adheres as a crust to the surface of the fibre.

manner sulphate of baryta and other pulverulent mineral bodies may be mordanted and dyed with decoctions of dyewoods.

With regard to the nature of the force which binds the coloring matter to the fibre—whether or no it be chemical attraction? Bolley concludes that there is no sufficient reason for accepting the view, principally developed by Chevreul [and by Kuhlmann, Comptes Rendus. Tomes xlii, xliii *et* xliv], that dyeing is a direct consequence of chemical affinity. He believes that the power possessed by fibres of attracting certain bodies—whether salts or coloring matters or both—from their solutions, belongs to that class of phenomena which results from the action of finely divided mineral or organic bodies (charcoal or bone black for example,) on such solutions. The distinction between the action of charcoal and of fibres in thus removing saline matters, or dyes, from their solutions is one of *degree* only, the nature of the operation being identical in either case.

A given weight of well prepared animal charcoal can, as a rule, deprive a larger quantity of liquid of its color than an equal weight of wool or silk. Neither wool or silk can remove *all* the color from a solution as charcoal can, their effect extending only to a certain degree of dilution beyond which the particles of coloring matter resist their attraction. Dyes which may have been taken up without a mordant by wool or, especially, by silk may be removed again by long washing in water, a fact which is not true in the case of charcoal, or only to a very slight extent. The attraction of coloring matters for water is therefore more completely overcome by charcoal than by animal fibre; but even the cleanest vegetable fibres, as, unmordanted and completely bleached cotton, possess a certain power of attracting coloring matter. That cotton should have less effect in this matter than wool or silk is not surprising in view of the great difference in the structure of cotton fibre as compared with that of the two substances last mentioned. It is well known that wool and silk in consequence of their physical constitution belong to the class of strongly absorbent or hygroscopic substances, *i. e.* in consequence of a certain porosity or looseness of their particles they swell up when moist and become easily penetrated by a liquid throughout their entire mass; on the other hand the cell-walls of cotton fibres are denser, less penetrable and at the same time thinner and therefore unable to contain the same quantity of liquid.

It has been often urged that since fibres, especially those of animal origin, not only exert an attraction for salts &c. but also possess the power of decomposing some of them, their action must be chemical But in this respect the behavior of charcoal is similar to that of the fibres. So too with regard to the increased attraction for color exhibited by mordanted cotton which is on a par with the fact observed by Stenhouse that the decolorizing power of wood charcoal is considerably increased by precipitating alumina upon it.

According to the Author mordants act by producing insoluble colors (lakes). Their behavior towards coloring matters in solution must be ascribed to chemical affinity, with which however the fibres themselves have nothing to do.

The so-called substantive dyes become insoluble from some other cause than the addition of a mordant, for example oxydation of protoxyd of iron, or of white indigo.

That common alum with which wool or silk has been impregnated is able to attract coloring matter from solutions and precipitate it on the fibres depends not upon the strength of the chemical affinity of these fibres for the coloring matter, but upon the fact (experimentally proved by Bolley) that they become saturated with the alum which cotton does not.

13. *Cellulose Digested by Sheep.*—The researches of several German chemists* have proved that the cellulose of plants is by no means so indigestible a substance as was at one time supposed, but that on the contrary it is digested in considerable quantities, by the ruminants at least, especially when a portion of the food of the animal consists of some substance rich in oil.

In order to ascertain to what extent the digestibility of cellulose may depend upon its state of aggregation, Sussdorf and A. Stœckhardt have undertaken a series of experiments, of which only a very brief abstract can be here given. From their results it is evident that even the most compact kinds of cellulose can be in great measure digested by sheep. The experiments, commenced in July, 1859, were upon two wethers respectively five and six years old. These were fed: 1st, upon hay alone; 2d, upon hay and rye straw; 3d, hay and poplar wood sawdust which had been exhausted with lye; in order that the sheep should eat the sawdust it was found necessary to add to it some rye-bran and a small quantity of salt; 4th, hay and sawdust from pine wood mixed with bran and salt; 5th, hay, spruce sawdust, bran and salt; 6th, hay, paper-maker's pulp from linen rags and bran; after several unsuccessful attempts to induce the sheep to partake of the pulp when mixed with dry fodder it was at last given to them in a sort of paste or pap prepared by mixing bran with water. The experiments were continued until November, with the exception of a short intermission during which the animals were put to pasture in order that they might recover from the injurious effects—probably due to the resinous matters of the spruce wood,—of the fifth series of experiments.

The animals, as well as their food, drink and excrements were weighed every day. The amount of cellulose in the excrements was also daily determined by analysis. The composition of the food ingested having been previously ascertained.

It appeared that when the animals were fed: (1.) with hay (35 lbs. per week), 60 to 70 per cent of the cellulose contained therein was digested, *i. e.* it did not appear as such in the solid excrements. In this experiment the animals gained 7½ lbs. in 18 days. (2.) With hay 14 lbs., and straw 7 lbs. (per week), 40 to 50 per cent of the cellulose of the straw was digested. The animals having lost 2½ lbs. in 11 days. (3.) With hay 10½ lbs., poplar saw-dust 5¼ lbs., bran 7 lbs. (per week), 45 to 50 per cent of the cellulose of the poplar wood was digested. The animals having gained 2½ lbs. in 13 days. (4.) With hay 10½ lbs., pine wood saw-dust 7 lbs., bran 10½ lbs. (per week), 30 to 40 per cent of the cellulose of the pine wood was digested. The animals having gained 10 lbs. in 24 days. (5.) With hay 9⅓ lbs., paper-maker's pulp 7 lbs., bran 14 lbs. (per week),

* For a portion of these interesting results, see: *Agriculturchemische Untersuchungen und deren Ergebnisse angestellt u. gesammelt bei der landwirthschaftlichen Versuchstation in Mœckern.* Leipzig, Wigand, 1852-57; also *Die landwirthschaftlichen Versuchs-Stationen.* Dresden, Werner, 1858-59.—F. H. S.

80 per cent of the cellulose of the paper pulp was digested. The animals having gained 7 lbs. in as many days.

These experiments are to be continued, and more particularly with a view of ascertaining whether any nourishing effect is to be attributed to the cellulose.—STŒCKHARDT'S *Chemischer Ackersman*, 1860, No. 1, p. 51.

II. GEOLOGY.

1. *Notes on the Geology of Nebraska and Utah Territory*, (in a letter to one of the Editors from Dr. F. V. HAYDEN, dated Fort Laramie, March 3d, 1860.)—It will be seen by referring to the several memoirs, published in connection with my associate, Mr. Meek, and the second edition of a geological map of Nebraska and Kansas, that the great Lignite Tertiary Basin covers a vast area in the northwest. We find by personal observation that it occupies the greater portion of the country bordering on the upper Missouri, Yellow Stone and Big Horn rivers, that it extends far up into the Wind river valley and west along the North Platte road to the Sweet Water mountains, the Cretaceous rocks being exposed here and there by local upheavals, only except along the base of the mountains.

The lignite beds, which are well developed south of Fort Laramie extending along the base of the Laramie mountains to the Arkansas and southward, furnishing the coal or lignite in the vicinity of Denver City and probably forming a part of the same basin.

I have, in a former paper, suggested that fresh-water deposits near Fort Bridger are probably on a parallel with the estuary beds of Judith river, which at that time were not positively known to be Tertiary. The facts now in my possession show, with a good deal of certainty, that they form the lower portion of the great Lignite Basin. These estuary deposits, which occur in a number of localities in the west and northwest, as along the Grand and Cannon Ball rivers, at the mouth of the Judith on the Missouri, near the mouth of the Big Horn on the Yellow Stone, seem to have ushered in the tertiary epoch of the West, which had already been foreshadowed in Cretaceous formation No. 5,* by the Tertiary character of the Mollusca. We have already, in a former paper, noted the fact that a large portion of the fossils peculiar to the Cretaceous formation No. 5, are closely similar to true Tertiary types and in most of the localities the transition from No. 5 to the estuary beds is scarcely perceptible. On the North Platte, especially at Deer Creek, No. 5, which is very largely developed in this region, is not unfrequently thrust up through the overlying lignite beds, charged with its characteristic fossils. Along the bluff banks of the stream, where the beds are but slightly disturbed, the order of sequence of the strata is so perfect that I would not have been in doubt where to draw the line of separation until we came to the first seam of lignite, and even then I would have considered several beds of the Lignite formation as the upper portion of No. 5 had I not found in these lower lignite beds *Unios* and other fresh-water shells, together with impressions of leaves identical with those occurring so abundantly in the Upper Missouri and Yellow Stone Tertiary strata, and furthermore these beds on the

* The Cretaceous series of Nebraska has been divided into five formations, which for convenience have been numbered from the base in ascending order, 1, 2, 3, &c.

North Platte have now been traced continuously over the intervening country from the mouth of the Yellow Stone river to the Platte. I have ascertained the fact that the lignite beds along the North Platte are a continuation of those on the Upper Missouri, and that they extend in their full developement far up into the Wind river valley and along the Platte road to the Sweet Water mountains. As yet I have seen no indications of lignite in any of the divisions of the Cretaceous period except in formation No. 1 near the Big Sioux river on the Missouri and in a series of sandstones and shales near Fort Benton which we have referred to the same rock. As we proceed south and southwest in this region No. 1 seems to disappear gradually, and along the Laramie mountains I cannot determine its existence at all.

The geographical extension of the great Lignite Basin seems to me to be one of the most interesting questions in the geology of the West at the present time. Very little is known as yet of its limits and from the interesting facts collected by Dr. Engelmann and from other sources it must occupy a large area to the southward and westward from this point, and we already know that it extends far northward into the Hudson's Bay vicinity.

In regard to the White river Tertiary Basin its boundaries have been published with a good degree of accuracy. Its limits north of the Platte river are now well known, and as I have already stated in a former paper, one of the upper members of that basin is revealed along this river, and these, in their southern and southwestern extension, pass by a gradual transition into the Yellow Marl or superficial deposits of the Quaternary period. That the White river Tertiary beds are of later date than those of the Lignite Basin, is clearly shown by the former having been observed resting conformably upon the latter in several localities.

2. *Note on Prof. Newberry's criticisms of Prof. Heer's determination of species of North American Fossil Plants*, in a letter to Prof. Asa Gray, Cambridge.—*Dear Sir:* When I offered for publication in this Journal, the translation of part of a letter from Prof. O. Heer, concerning some fossil plants of the Tertiary, I was far from supposing that any of the statements of my learned friend would not appear satisfactory to every one interested in the study of our American Palæontology. Much less could I foresee that those statements would be construed in a manner that I do not think quite justifiable. As Prof. Heer's letter was published without his knowledge and sanction, I am forced, much to my regret, to defend his position against Dr. Newberry, a personal friend also, and a true and faithful pioneer in the field of our botanical palæontology.

I know nothing about the discussion on the Cretaceous formations and fossils, except what has been published in this Journal. And although last year, during my connection with the State Geol. Survey of Arkansas, I had the opportunity of examining well exposed strata at different stages of the Cretaceous, I was unable to find there any fossil plants, and therefore I have never seen as yet an American Cretaceous plant. Thus I can take my arguments only from the statements of Dr. Newberry himself. It is unnecessary to recall the five points in discussion.

The two first statements are, even from the assent of Dr. Newberry, satisfactorily explained by the insufficiency for exact determination of

sketches made from incomplete specimens. Nevertheless, it is but right to remark in favor of the opinion of Dr. Heer that *Populus Leuce* has not the leaves toothed as Dr. Newberry says, but only *subdenticulate*, following Unger's figure and description. Moreover, species of *Populus* bear toothed and entire leaves on the same branches.

The third assertion, about the value of the genus *Ettingshausenia*, concerns only the author of the genus and has nothing to do with the determination of the species. There was no call for a critique upon Prof. Heer on this account.

The fourth statement is the only essential one; it is: "that *excepting the so-called Credneria and Ettingshausenia, all the genera enumerated in Dr. Newberry's letter are Tertiary and not Cretaceous.*"

Nobody will consider as identical the genera *Salicites* and *Salix*, *Alnites* and *Alnus*. Then, from the eleven genera enumerated by Dr. Newberry, two only are found in the list of Hiehle, containing seventeen genera. These two genera are *Populus* and *Acer*, the true characteristic genera of the tertiary of Europe. The first is represented already in that formation by thirty-three species; the second by forty-five or more, and except the species admitted by Hiehle, not a single one has been found in the Cretaceous. From the nine other genera of Dr. Newberry which are not mentioned as Cretaceous by Hiehle, not one has been found by anybody else in that formation. Hence Prof. Heer was right to say that, except the two which he named, all the genera enumerated in the letter of Dr. Newberry were of the Tertiary and not of the Cretaceous. Every botanist without exception would have come to the same conclusion.

Therefore I cannot understand how the accusation of ignorance or of partiality could be brought against the celebrated Professor of Zurich. How it could be thought that a naturalist who has spent his life, without regard to personal interest, in the constant pursuit of his favorite science (the Botanical Palæontology of all the formations), could be supposed to ignore not only the fossil flora of the Cretaceous, but what Hiehle has published in the Palæontographia. This work is in every library and Prof. Heer has quoted it all along in the three volumes of his admirable Fossil-flora of the Tertiary! And how a man of such high moral standing as Prof. Heer, respected everywhere for his faithfulness and devotion to science, could be accused of giving his opinion or rates of determining the plants from a *judgment biased by erroneous oral testimony*, is still more inconceivable to me.

In the letter of Prof. Heer, there is not a word which could be construed as censurable or offensive to anybody. When the most learned Botanists take again and again species and genera for re-examination, new determinations, for a constant changing of names, of relations, of affinity, even with specimens of living plants; when such Palæontologists as Heer, Corda, Unger, Göppert, Braun, &c., who have on hand the largest libraries, numerous specimens, and every facility for comparing them are forced every day, either by new discoveries or by a more careful study, to acknowledge mistakes and to change their nomenclature; when the same fossil leaf is for different authors a *Populus*, a *Salix*, a *Laurus*, a *Ficus*, a *Quercus!* it cannot be expected that in America, where the science of Botanical Palæontology is scarcely born,

where the age of the strata from which the fossil plants are taken is mostly uncertain, where we have no possibility of comparing specimens, and not a single library where we can find all that has been published on palæontology, we can come at once by some kind of divination to the correct determination of a fossil species. And most commonly the examination has to be made on pieces of broken specimens of leaves, of which the general outline and the details of nervation are obliterated. We have thus to begin and to break the way, and the only means of doing it with advantage to our successors is to publish our fossil species as fast as we can get them, figuring them carefully and determining the species as well as we can without caring for any foreign opinion.

About the fifth statement of Prof. Heer, I can not admit, as Dr. Newberry appears to do, that the fossil flora of the American Cretaceous ought to be closely related to the European. The Tertiary of North America, of which numerous specimens have recently been collected in Mississippi, Tennessee and Kentucky, has some of the genera of Europe, *Sabal*, *Phœnicetes*, *Laurus*, &c., represented by peculiar species different from those of Europe, with a large number of *Terminalia*, *Magnolia*, two genera scarcely represented in the European tertiary. But this question cannot be examined now.

Contrary to the supposition of Dr. Newberry, it is certain that the fossil plants obtained from three different stages of the Tertiary in Mississippi, Tennessee and Kentucky, indicate a warmer climate than that of the same latitude at our time. And it is certain also that already two marine fossiliferous beds (very rich indeed) have been discovered, the one near Cairo in Illinois, by Prof. A. H. Northen; the other near Oxford, by Prof. Hilgard, and perhaps a third one in Tennessee by Prof. Safford,—three State Geologists of the three different States. I have spent some time last fall in the examination of the formations; and besides the specimens of fossil leaves which I have collected, I have now for examination the rich collection of the Mississippi University of Oxford, and the private collections of fossil plants of both Prof. Hilgard and Prof. Safford. It is from these materials partly examined that I have taken the above conclusions.

Respectfully Yours, LÉO LESQUEREUX.

Columbus, Ohio, April 3, 1860.

III. BOTANY AND ZOOLOGY.

1. *Florula Ajanensis*, by REGEL and TILING. Moscow, pp. 128, 4to, 1858. (Extr. Trans. Imp. Soc. Mosc.)

Primitæ Flora Amurensis, by C. J. MAXIMOWIEZ. St. Petersburg, 1859. (Extr. Mem. present. Acad. Im. Sci. St. Petersb.), pp. 504, tab. 10, 4to.—The first-named work, with the *Florula Ochotensis* of Trautvetter and Meyer in Middendorf's Journey, gives an account of the botany of the confines of Northeastern Siberia bordering on the Ochotsk Sea. The latter, a bulky volume, contains the first fruits of the botanical explorations consequent upon the colonization of the lower part of the Amoor River by the Russians. These districts nearly abut upon the northern part of Japan, and therefore possess for us a peculiar botanical interest. They share notably, though not as largely as Japan, in those North American types which present so curious a problem in geographical dis-

tribution. Having been supplied with an almost complete suite of the specimens upon which these works are based, through the generosity of the directors of the Imperial Botanic Garden and of the Museum of the Imperial Academy of Sciences of St. Petersburg, we wish to collate the various representative forms both with our Japanese materials and with their American relatives before we offer any definite remarks. Suffice it now to say, that the Amoor flora offers several additional species identical with peculiarly Eastern North American ones: e. g. *Acer spicatum*, *Pilea pumila*, *Asplenium thelypteroides*, and *Symplocarpus fœtidus!* Also several closely representative ones; such as *Caulophyllum robustum*, doubtless the same as the Japan plant, which in fruit answers perfectly to our *C. thalictroides*, and I still suspect not distinct from it; and *Maximoviczia Chinensis*, Rupr. (to which evidently belongs *Sphærostema Japonicum*, Gray), a close counterpart of our *Schizandra*; *Acer tegmentosum*, very nearly our *A. Pennsylvanicum*; *Hylomecon vernalis* which seems very close to our *Stylophorum diphyllum*; and *Plagiorhegma dubium*, which has the look of a monstrous dicarpellary *Jeffersonia*. Indeed, good flowers are still wanting to make it at all certain it is not a *Jeffersonia!*

Very remarkable indeed is this division of monotypic or nearly monotypic genera or groups between Northeastern Asia and Northeastern America,—of which so extended a list can now be given,—and very suggestive is it (at least where the species are identical or nearly so) of a comparatively recent communication between the two countries. A. G.

2. *Harvey's Thesaurus Capensis*, No 2, has come to hand. The plates (26–50) are better printed and do more justice to Dr. Harvey's facile pencil than those of the first part. Among the illustrations is a new *Crotalaria*, "a sort of first fruits of the botany of Lake Ngami;" an interesting new Bixaceous genus (*Rawsonia*), with petaloid scales "evidently homologous with the crown of *Passiflora*, and with the inner stamens hypogynous, the outer perigynous"; also a fine new Scuphularineous genus, *Bowkeria*.—No. 3, just received, continues the work to plate 75. One of the plates illustrates a new genus of the Passion-flower family, with blossoms no larger than chickweed. A. G.

3. *Hooker's species Filicum, being Descriptions of all known Ferns*, illustrated with Plates. Part ix, or vol. iii, part 1. pp. 64, tab. 141–170.—This portion of this important and standard work contains the genera *Lomaria* and *Blechnum*, and excellent figures of 23 species. The most interesting Fern to us, here illustrated, is the *Blechnum doodiodes* of Hooker, known only from two specimens gathered by Douglas somewhere in Northwestern America, "probably up Frazer's River": the question is whether the plant may not prove to be a remarkable variation of *Lomaria Spicant*, which inhabits that region, and is the only Lomarioid Fern of so northern a latitude. A. G.

Part x, or vol. iii, part 2 of this important work has just come to hand. It comprises the first part of the very large and very difficult genus *Asplenium*, the reduction of which to order will be a great boon to botanists.

4. *Journal of the Proceedings of the Linnœan Society*, No. 14: Botany.—This part concludes Prof. Andersson's account of the *Salices* of the East Indies, 34 species, of which many are new. Mr. Spruce has a short article on the Piassaba Palm (*Leopoldinia Piassaba*) of the Rio Negro of the Am-

azon, the long fibrous beard of whose petioles (vestiges of the membrane which envelopes the frond in vernation) is so important for cordage, &c. On young palms this pendant beard is four feet or more in length, and reaches to the ground. Besides this useful fibre, the pulp of the ripe fruit of this palm is said to yield the most delicious of all palm-drinks, having great resemblance to cream both in color and taste. The remaining article is one by Mr. Mitten, upon various new *Musci* of New Zealand, Tasmania, and various parts of the Southern hemisphere.

No. 15, contains Observations on the Growth and time of Appearance of some of the Marine *Algæ*, by Dr. Cocks; and another of the Præcursores ad Floram Indicam, by Drs. Hooker and Thomson. The present paper is devoted to the *Balsamineæ*, amounting to about one hundred species, notwithstanding a large reduction. The great mass of the order belongs to India; the extra-Indian Balsams known being about eight in more oriental parts of Asia and Maylasia; about as many more in Africa and Madagascar, three in Europe and Siberia, and two in North America. The Indian species are "so universally and excessively prone to vary" that they have given their monographer immense trouble and small satisfaction. We may remark that our two American species and *I. Nolitangere* of the Old World seem to run together; at least, intermediate forms occasionally appear which strongly suggest a common origin. A. G.

No. 16. contains a paper by Mr. Babington on the forms or species compared with *Fumaria capreolata*, L.; another on a new Butter-tree of Southeastern Africa by T. Caruel of Florence,—the tree which Bertoloni supposed to be the shea-tree mentioned by Mungo Park, and which he described as the type not only of a new genus but of a new order. Mr. Caruel shows that the present tree is a *Combretum*, and doubtless not the shea-tree, the only grounds for considering them the same being that both belong to Africa, and both produce a kind of vegetable butter. Mr. Oliver, a young English botanist of promise, describes some new South American species of *Utricularia* (two of which are figured), with notes on *Polypompholyx* and *Akentra*, showing that Benjamin established the latter in a mistaken observation, and that the plant is an *Utricularia*. Mr. Spruce gives a very interesting account of a visit to the *Cinchona* forests of the Quitenian Andes. The *Cascarilla roja* was said to have a milky juice, a remarkable circumstance for a Rubiaceous plant. It appears that the juice as it flows from a wound is colorless, but that it turns white the instant it is exposed to the air, and in a few minutes changes to red. Mr. Moore announces the discovery in England of *Lastrea remota* (*Apidium remotum*, Braun), a form which has been confounded with *A. rigidum* and which appears to be as intermediate between *A. spinulosum* and *A. Filix-mas*, as *A. rigidum* is between the former and *A. cristatum*. Mr. Oliver continues an account of the British Herbarium now forming for the Linnæan Society; and Mr. Hogg, a note on the *Rosa rubella* of Winch., giving evidence that it is a mere variety of *R. spinosissima*. A. G.

5. *Martius, Flora Brasiliensis.*—This great work is conducted with such spirit,—now that the distinguished editor is able to devote his whole attention to it,—that three fasciculi reach us at the same moment, viz.:

Fasc. 18, part 3, is a supplement to the *Myrtaceæ* of Brazil, by Berg, of Berlin. This young botanist is thought to have elaborated the Amer-

ican forms of this great order in an able manner. Of the many new species and varieties described in this supplement, the greater part are from the Brazilian collection of Riedel, belonging to the Imperial Botanic Garden of St. Petersburg, and furnished to Dr. Berg by Dr. Regel, the accomplished curator of that establishment. To this is appended a tabular view of the geographical distribution of all the known American *Myrtaceæ*, now amounting to 1726 species, of which 1008 are nearly described by Berg (in the Fl. Brazil., and in the Linnæa), and 696 are indigenous to the Brazilian empire. The uses which the plants of the order are known to subserve in Brazil are likewise enumerated. Of four species the root, or its bark, is used medicinally: of three species the fibrous bark is turned to account, among which, from that of a *Couratari* the natives of the Uapes make clothing; the timber of *Couratari legalis*,—one of the largest trees of tropical Brazil—is so highly prized for a variety of purposes that its wasteful destruction is forbidden by law, whence the name *paos de ley*, i. e. *ligna legalia*: the leaves of several species are used medicinally for their aromatic properties combined with astringency: the flower-buds of a *Calyptranthes* are used as a substitute for the true Clove, which also is cultivated successfully in Brazil: the berries of no less than 55 species are enumerated as edible, or some of them medicinal; the most important being the *Guayavas*; five species of *Lecythis* and the famous *Bertholletia excelsa* furnish amygdaloid seeds of great richness and pleasantness (Brazil-nuts, &c.). Recent extrabrazilan genera are briefly noted. *Luma* (Bot. U. S. Expl. Exped.) is altogether overlooked, and in strictness may claim restoration, when the genera come to be revised and considerably reduced, as they probably will be. The three parts of fasc. 18, composing the *Myrtographia Brasiliensis* compose an entire volume, of 655 pages, with many plates.

Fasc. 23, is a continuation of the first fascicle (*Musci* and *Lycopodiaceæ*), and comprises the *Ophioglosseæ*, *Marattiaceæ*, *Osmundaceæ*, *Schizæaceæ*, *Gleicheniaceæ*, and *Hymenophylleæ*, by Dr. Sturm, of Nuremberg, with ten plates. One of these is a fine illustration of the rare and curious *Ophioglossum palmatum*,—a species which, by the way, Mr. Wright has lately collected abundantly in the eastern part of Cuba. Under the name of *Osmunda palustris*, Schrad., our North American *O. spectabilis*, a form of the European *O. regalis*, is figured: it appears to be rather common in the southern part of Brazil. It is interesting to remark that both this and two other more specially North American species, viz. *O. cinnamomea* and *Botrychium Virginicum*, occur on the one hand in Brazil, on the other in the Himalayas. The illustrations of the *Hymenophylleæ* are nature-printed, by the Vienna process. This does better for the fronds—so delicate in this tribe—than for the fructification.

Fasc. 24, of 215 pages, with 56 plates, contains the first part of Mr. Bentham's elaboration of the Brazilian *Leguminosæ*, including all the *Papilionaceæ* except the *Dalbergieæ* and the *Sophoreæ*. A double plate, filled with details, illustrates the structure of *Arachis*, the generic character of which, as well as of its allies, is remodelled, conformably to the observations of Dr. Niesler, as recorded in this Journal, several years ago. We perceive that the North American species referred to *Chæto-*

calyx (the fruit of the original species being unknown), belong to the allied and older genus *Nissolia*. *Chætocalyx Wislizeni*, Gray, is the same as *Nissolia platycarpa*, Benth. *C. Schottii* must take the name of *Nissolia Schotti*. A. G.

6. *J. D. Hooker's Flora Tasmania*,—the third and concluding part of the *Botany of the Antarctic Voyage* under Capt. Ross,—is now finished in parts 10 and 11, issued by the enterprising publisher, Lovell Reeve, in February last. The work makes two large quarto volumes, with 200 colored plates. Part 10 concludes the *Algæ* (by Dr. Harvey) and contains the *Lichenes* (the foliaceous ones by Mr. Babington, the crustaceous by Mr. Mitten), also a series of additions and corrections to the earlier part of the work. The letter-press of part 11 is entirely occupied, excepting the key to the genera, by the *Introductory Essay* upon the Botany of Tasmania and of Australia in general, of 128 pages, which admirable production may claim to be regarded as the most profound and far-reaching discussion of the abstruse theoretical questions bearing upon the origin and distribution of species which has ever been attempted. Although the literary composition bears some marks of haste, the subject-matter has been elaborated with great care, and in a manner at once bold, independent, and conscientious, opening new views and propounding new problems of the widest interest and, we may add, of the utmost difficulty. The more generally interesting portions of this essay are reproduced in the present volume of this Journal. A. G.

7. *Poison of Plants by Arsenic.*—It may be recollected that Professor Davy of Dublin last year reported to the Gardener's Chronicle (whence extracts were transferred to our pages*) the results of his experiments which went to show that some plants might with impunity be watered even with a saturated aqueous solution of arsenious acid; that the plants took up this arsenic and accumulated it in their tissues, to such an extent that traces of this metal were discoverable in the bodies of animals fed upon vegetables so treated. These astonishing results naturally excited enquiry. They have now been contradicted in a late number of the Pharmaceutical Journal (as we learn from the Gardener's Chronicle for March 10) by Mr. Ogston, an analytical and agricultural chemist, formerly a pupil of Prof. Graham. Mr. Ogston finds that, on watering the ground around the roots of some vigorous Cabbage plants, some months old, with a saturated solution of arsenious acid, in every trial, after two doses at intervals of three days, the plants died within the week. The same occurred with Scotch Kale, the only other plant subjected to the experiment. On testing the dead plants arsenic was detected only in the portion of the stem close to the roots, and which showed in its darkened color the marks of disease. In no case was any of the poison found in the leaves, or in the stem at more than five inches above the ground. Prof. Davy also startled the English agriculturists and medical jurists by calling attention to the fact that arsenic exists in the commercial superphosphate of lime, at least in certain kinds, coming from the iron pyrites used in the manufacture of the sulphuric acid employed in the production of the superphosphate, which arsenic, if plants may accumulate it in their tissues, would be conveyed

* Vol. xxviii, p. 443, 1859.

to the flesh of animals fed with turnips manured with such superphosphate, and so conveyed to the human system,—if not in quantity sufficient to poison, yet enough to account for the presence of arsenic in cases of death from supposed poisoning. Mr. Ogston now considers the question as to how much arsenic an agricultural crop (say of turnips) can obtain from an ordinary dressing of the superphosphate so prepared. "Take a very bad sample of pyrites to contain ·30 per cent of arsenic, and consider, as is the case, that in the manufacture of oil of vitriol, one-half of this is stopped by condensation in the flues; ·15 per cent will remain in relation to the pyrites, or about ·10 in relation to the manufactured oil of vitriol. Now suppose the superphosphate made from this acid to contain 20 per cent of it as a constituent, and that 3 cwt. are used as a dressing per acre, there will be added to this acre ·07 of a pound of arsenic, and this is to be distributed among from 20 to 25 tons of roots, giving a percentage infinitely small, and in my opinion relieving us from the necessity of the smallest anxiety on the subject. If, however, even this quantity is objectionable, the use of the Belgian pyrites, in which I have never found a trace of arsenic, would obviate all difficulty." A. G.

8. *Botanical Necrology for the year* 1859.—The following are the principal names upon this obituary record:—Some of them we have named before more briefly.

C. A. Agardh, Professor of Botany in the University of Lund, Sweden, from 1812 to 1834, when he became bishop of Carlstad; a voluminous writer upon botanical and other subjects, especially upon *Algæ*, and a distinguished and remarkable man. His earliest publication, a thesis upon the *Carices* of Scania, was published in the year 1806. He died on the 28th of January, 1859 at the age of 75 years. He was succeeded in his professorship by his son C. A. Agardh, the distinguished algologist.

Arthur Henfrey, Professor of Botany in King's College, London. The death, after a short illness, on the 7th of September last, of this amiable man and excellent vegetable anatomist, at the early age of 39 years, has has already been recorded in this Journal, (vol. 28, p. 443). In his field of research and in his knowledge of the literature of the subject, especially that of the Germans, he had no rival in Great Britain, and his death is deeply felt.

Dr. Thomas Horsfield, born in Pennsylvania, after completing his medical studies in Philadelphia he passed sixteen years in Java and the adjacent islands, in the service of the government, devoting much of his time to botanical and zoological researches; and the long remainder in a responsible position at the India House, in London. A selection only of his botanical collections was published by Mr. Brown and Mr. Bennett, under the title of *Plantæ Javanicæ Rariores*, etc.—a most important work. Dr. Horsfield died, on the 14th of July last, in the 86th year of his age.

A. L. S. Lejeune, a venerable Belgian botanist, died at Verviers, at the very close of the year 1858, in the 80th year of his age.

Thomas Nuttall, born at Settle, in the West Riding of Yorkshire, in the year 1784, may yet be reckoned as one of our own American botanists, since he came to the United States when only 22 years of age, and

made here his whole scientific career. He returned indeed to his native land in the year 1842, and took possession of a handsome estate bequeathed by his uncle, where he indulged his fondness for horticulture; but his only botanical publication in these later years was made at Philadelphia, and elaborated during a visit to this country in 1852. His writings are intimately connected with the history of North American Botany, and his personal biography is very interesting. A full account of these is given by Mr. Durand, in an excellent address delivered to the Philadelphia Academy of Natural Sciences, and in an article by Mr. Meehan in his Gardener's Monthly for January, 1860. A critical estimate of Mr. Nuttall's contributions to science must be deferred to another occasion. He died at his residence, Nutgrove, near Preston, Lancashire, on the 10th of September last, aged 75 years. A. G.

Zoological Notices.—

1. *A trip to Beaufort, N. Carolina;* by Wm. Stimpson, M.D.—The vicinity of Cape Hatteras, the most projecting point of our coast south of New York, has a peculiar interest for the student of zoology. This cape, which divides the Areniferous region* into two nearly equal parts, the Virginian and Carolinian provinces, is remarkable for the exhibition of a fauna more tropical in character than that of either of these provinces, as will be shown below. This is an evident result of its proximity to the Gulf Stream, the warm waters of which are even said to be deflected directly upon the Cape after violent southeast gales.

Beaufort, N. C., which lies several miles WSW from the Cape, in latitude 35° N. is the only convenient point of departure for explorations in the waters of the vicinity. Some account of the zoological richness of this locality was kindly communicated to me by Capt. J. D. Kurtz, U. S. A., and influenced by a desire of completing a catalogue of the shells of our Atlantic shores, and particularly of procuring and examining a species of *Lingula* said to be found on the southern coast, I undertook its exploration in the month of March last, in company with my friend Mr. Theodore Gill. The harbor of Beaufort is situated at one of the southern outlets of Pamlico Sound, where it joins Bogue Sound. It is shallow and much obstructed by extensive shoals. Centre-board boats only can be used, except in the deeper channels, which are mostly narrow. The bottom is generally sandy, but that of the deep channels is shelly, and that of the shallower channels often muddy. Outside the harbor and off the coast, the depth never exceeds eight fathoms within a few miles of the land, with a variable bottom, sometimes "sticky" or clayey. These bottoms were all pretty thoroughly raked with the dredges. The beaches were also examined for those bivalve shells which perforate the sand to a

* The eastern coast of the United States may be conveniently divided into three regions, viz.—the Rupiferous, Areniferous, and Coralliferous, named from the character of the shores. The Rupiferous or rocky region extends from our northern limit to Cape Cod, or Long Island. The Areniferous or sandy region,—in which there are no rocks whatever and scarce even a pebble except where human agency has been at work—reaches from Long Island to North Florida. The Coralliferous region is characterised by the presence of reef-coral, and includes the peninsular of Florida. Each of these regions has its peculiar fauna, the distinctness of which, enhanced by the two great causes of difference of latitude and diversity of ground, is too well known to require further comment here.

depth beyond the reach of the dredge and are only exposed by the eroding action of the breakers during heavy storms. In following these beaches we observed a decided increase of the tropical character in the shells as we proceeded eastward toward the Cape.

In order to show the character of the fauna and the results of our explorations I have given below a catalogue of the Mollusca and higher Crustacea which occurred during our short stay, which seems to be the most concise and satisfactory method. A few prefatory remarks of a general character will not be out of place. Geologists will be interested to notice the occrrence of several species hitherto known only as Tertiary fossils, such as species of *Axinaea*, *Lucina*, *Astarte*, *Amphidesma*, *Tellidora*, *Myalina*, *Panopaea*, *Entalis*, and *Columbella*. These were found either alive or in such condition as showed them to be recent shells, which would doubtless have been found alive upon further search. The occurrence of *Myalina subovata* is interesting, although our specimens of this species, as of *Amphimesma constricta*, are not certainly recent, being only single valves. Of the beautiful *Tellidora lunulata* we obtained several living examples, some attaining a length of nearly two inches. Among the shells of a tropical character several species will be noticed which have not hitherto been found north of the West Indies, and do not exist upon the South Carolina coast. The large *Cassis* to which we have applied the name *C. cameo* is identical with the common cameo-shell of the Bahamas, which usually figures in collections under the name of *C. madagascarensis*. Of this we obtained several fine specimens on the beaches, none living however.

In the following catalogues all species of which the identifications is at all doubtful are indicated by the mark of interrogation.

Mollusca.

Cynthia vittata.
Molgula sp.
Ascidia sp.
Lingula pyramidata.
Anomia ephippium.
Ostrea virginiana.
" equestris.
Plicatula depressa.
" sp.
Lima scabra?
" sp.
Pecten dislocatus.
" concentricus.
" nodosus.
Axinæa charlestonensis.
" sp.
Arca Holmesii.
" americana.
" cælata.
" lienosa.
" noæ?
" ponderosa.
" incongrua.
Nucula proxima.
Yoldia limatula.
Leda acuta.
Pinna squamosissima.
" carolinensis.
Avicula atlantica.
Modiolaria lateralis.
Modiola plicatula.
" americana.
" tulipa?
Mytilus edulis.
" cubitus.
Chama arcinella.
" macrophylla.
Cardium magnum.
" isocardia.
" muricatum.
Liocardium serratum.
" Mortoni.
Lucina crenulata.
" cribraria?
" edentula.
" strigilla.
Felania sp.
Diplodonta? punctata.
Lepton lepidum.
Astarte lunulata.
" undulata?
Cardita tridentata.
Mercenaria violacea.
" Mortoni.
" notata.
Trigona sp.
Venus rugosa?
Chione cancellata.
" pygmæa?
Callista gigantea.
" maculata.
Dosinia discus.
Lucinopsis sp.
" n. sp.
Petricola pholadiformis.
Raëta canaliculata.
" lineata.
Mactra oblonga.
" similis.
" lateralis.
Donax variabilis.
Cumingia tellinoides.
Semele orbiculata.
" reticulata?
Amphidesma constricta.
Abra æqualis.
Tellina alternata.
" fausta?

Tellina polita.
" tenera.
" versicolor?
" tenta.
" iris.
" constricta.
" sp.
" n. sp.
Strigilla carnaria.
" flexuosa.
Tellidora lunulata.
Solen ensis?
" viridis.
Siliquaria gibba.
" bidens.
Solenomya velum.
Mya arenaria.
Corbula contracta.
Myalina subovata, *Con.*
Panopæa americana.
Saxicava distorta.
Gastrochæna sp.
Lyonsia hyalina.
" sp.
Pandora trilineata.
Pholas costata.
" truncata.
Pholadidea cuneiformis.
Teredo sp.
Polycera sp.
Actinodoris? sp.
Utriculus canaliculatus.
Bulla solitaria.
Tornutella puncto-striata.

Chiton apiculatus.
Entalis pliocena.
Dentalium sp.
Crepidula unguiformis.
" fornicata.
" convexa.
Clypidella pustula.
Fissurella alternata.
Zizyphinus sp.
Turbo crenulatus.
Littorina irrorata.
Scalaria Humphreysii.
" turbinata.
" lineata.
" novangliæ?
" multistriata.
Solarium granulatum.
Vermetus radicula.
Cerithium sp.
Bittium nigrum?
" Greenii.
" sp.
Triforis nigrocinctus.
Odostomia seminuda.
" impressa.
Turbonilla interrupta.
" sp.
" sp.
Obeliscus crenulatus.
Eulima oleacea.
Catinus perspectivus.
Natica pusilla.
Neverita duplicata.
Volva uniplicata.

Pleurotoma cerina.
Mangelia rubella.
" filiformis, *Holmes.*
Oliva litterata.
Olivella mutica.
Columbella avara.
" ornata.
" lunata.
" n. sp.
Dolium galea.
Semicassis granulosa.
Cassis cameo, *Stm.*
Purpura floridana.
Murex spinicostatus.
Nassa obsoleta.
" trivittata.
" vibex.
" ambigua?
Cerithiopsis terebralis.
" ? n. sp.
Acus dislocatus.
" concavus.
Busycon pyrum.
" canaliculatum.
" carica.
" perversum.
Cancellaria reticulata.
Fasciolaria gigantea.
" tulipa.
" distans.
Ranella caudata.
Strombus alatus.

Crustacea Decapoda.

Libinia canaliculata.
Pelia mutica.
Leptopodia calcarata.
Cryptopodia granulata.
Cancer irroratus.
Menippe mercenaria.
Panopeus Herbstii.
Pilumnus aculeatus.
Platyonichus ocellatus.
Lupa hastata.
" Gibbesii.
" spinimana.
Gelasimus pugilator.

Ocypoda arenaria.
Pinnotheres ostreum.
" maculatus.
Pinnixa cylindrica.
" sayana.
" chætopterana.
Persephona punctata.
Lithadia cariosa.
Hepatus decorus.
Calappa marmorata.
Porcellana ocellata.
" sociata.
Euceramus prælongus.

Hippa talpoida.
Lepidops scutellata.
Eupagurus pollicaris.
" longicarpus.
" annulipes.
Callianassa major.
Crangon septemspinosus.
Alpheus intermedius.
Virbius pleuracanthus.
Palæmonopsis carolinus.
Penæus brasiliensis.
" constrictus.

In the collection made at Beaufort and now deposited in the Smithsonian Institution a considerable number of new genera and species occur. We add descriptions of two of the most interesting.

LINGULA PYRAMIDATA. Shell greenish-white, elongated-ovate, convex, regularly tapering from the middle to the summit with an outline very slightly convex; also a little tapering toward the extremity, which is less than two-thirds as wide as the middle, and subtruncate with broadly rounded corners. Surface smooth and glossy; lines of increment inconspicuous, but sufficiently distinct near the margins; two or three of them however at irregular intervals sometimes projecting more strongly, indi-

cating epochs in the growth of the shell. Marginal setæ of the mantle well developed, those on either side at the extremity longer than the rest, equalling in length one-third the width of the shell. There are two black spots on the margin of the mantle at the extremity. Peduncle in life three times as long as the shell, thick, (one-third width of the shell,) at its point of attachment, but rapidly tapering and becoming very slender and hyaline, with an opaque axis or central cord; extremity glutinous and covered with adhering sand. Length of the animal 3·5; length of shell, 0·92; width of shell at the middle 0·35; at extremity, 0·21; half way between middle and summit, 0·26 inch.

This animal was found imbedded in the weedy sand at low water mark, on the occasion of one of the extraordinarily low tides which occur at the equinox. It lives in a perpendicular position with its peduncle deeply penetrating the sand, and its shell scarcely projecting above the surface at its extremity. When drawn out and placed in a vessel of sea-water it showed its uneasiness by snake-like gyrations of the peduncle, which, far from being a simple stem for attachment, is a powerful muscular organ, filling the function of the foot of the Lamellibranchiata. Mr. Peale informs me that this part in the *Lingula anatina* forms a favorite article of food among the Fiji Islanders. Our Lingula appears to be not uncommon near Beaufort, as several specimens were found during a single retreat of the tide. It is interesting as being the first species* of this most ancient genus described from the Atlantic ocean. The other recent species, ten in number, are all inhabitants of the Pacific.

Euceramus, nov. gen. fam. *Porcellanidae.* Body subcylindrical. Carapax elongate-subrectangular, twice as long as broad; sides parallel. Front prominent, tridentate. Eyes minute, longitudinal, projecting a little beyond the orbits which are very incomplete, consisting only of the concave superior margin. Antennulæ placed immediately beneath the eyes; peduncle anteriorly bidentate. Antennæ large; mobile part nearly as long as the carapax and arising from the inner or superior side of the small coxal joint, thus being in contact with the eye at base. The outer maxillipeds are of the form usual in Porcellana, but the sternal piece to which they are attached is very large, nearly as long as broad, triangular in front, and truncate behind. Chelipeds small, subcylindrical, much shorter than the carapax; hands weak. Ambulatory feet subcylindrical; dactyli curved, setose, nearly as long as penult joint. Abdomen narrow, particularly in the males; appendages as in Porcellana.

This aberrant type should be referred to the Porcellanidea, notwithstanding its greatly elongated form, which would lead one to refer it at first sight to the Hippidæ or Raninidea.

Euceramus prælongus. Carapax regularly curved like a segment of a cylinder, above glabrous, and minutely striated transversely; striæ curved forward at the sides. Inter-orbital front one-third the width of the carapax, tridendate, teeth slender, pointed, median longest. Hands externally scabrous, or small-tuberculose and setose; fingers as long as the palm and not gaping. Ambulatory feet of the second and third pairs as long as the chelipeds; those of the first pair smaller. Length about three-fourths of an inch. Dredged on shelly ground in 4 to 8 fathoms.

* We understand that there is a specimen of Lingula from the coast of South Carolina in possession of Prof. Agassiz. Not having access to this specimen, we are unable to say whether it be identical with ours or not.

IV. METEOROLOGY AND ASTRONOMY.

1. *Abstract of Meteorological Observations, made during the year* 1859 *—with the average of seven years—at Sacramento, Cal., lat.* 38° 34′ 41″, long. 121° 29′ 44″; by THOMAS M. LOGAN, M.D.

1859.	January.	Feb'y.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Mean.	7 years average.
Barometer.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Maxima,	30·491	30·332	30·385	30·371	30·171	30·211	30·066	30·080	30·126	30·270	30·326	30·368	30·266	30·243
Minima,	29·438	29·626	29·771	29·698	29·744	29·605	29·747	29·731	29·725	29·694	29·791	29·788	29·697	29·706
Mean,	30·211	30·026	30·151	30·004	29 976	29·836	29·917	29·892	29·927	29 943	30·040	30 167	30 008	30·004
Thermometer.	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Maxima,	57·00	62·00	64·00	76·00	80·00	96·00	87·00	85·00	82·00	83 00	68·00	53·00	74·42	75·80
Minima,	34·00	39 00	40·00	40·00	53·00	61·00	60·00	58·00	56·00	49·00	42·00	34·00	47·17	46·70
Mean,	44·87	50·49	51·47	57·11	63·03	74·85	69·07	67·16	65 89	63 28	54·05	43 52	58·73	59·36
Thermometrograph.	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Maxima,	58·00	63 00	66 00	78·00	84 00	102 00	92 00	89·00	85 00	87·00	70·00	54·00	77·33	77·99
Minima,	30·00	34·00	36 00	36·00	45 00	51·00	51·00	52·00	50·00	43·00	37 00	28·00	41·08	41·46
Range,	28·00	29·00	30·00	42·00	39·00	51·00	41·00	37·00	35·00	44 00	33 00	26 00	36·25	36·53
Force of Vapor.	In.	In	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Maxima,	·362	·436	·410	·524	·522	·942	·677	·564	·581	·524	·529	·334	·534	·529
Minima,	·120	·173	·078	·133	·136	·296	·338	·350	·226	·186	·189	·087	·193	·197
Mean,	·231	·289	·257	·321	·363	·503	·469	·451	·410	·367	·347	·230	·353	·357
Relative Humidity.	Per ct.	Per ct.	Per ct.	Per ct	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Maxima,	93·00	94·00	92·00	87·00	82·00	82·00	77·00	82·00	84·00	85·00	94·00	92·00	87 00	87·81
Minima,	32·00	60 00	19·00	30·00	19·00	18 00	36 00	29·00	25·00	32·00	51·00	30·00	31·75	31·26
Mean,	78·05	78·73	68·32	68·90	64·81	59·51	66·95	68·68	65·61	64·41	82 32	80·30	70·55	69·95
Number of clear days,	7	3½	11	10½	14½	20½	22½	25½	16½	16½	4	10½	162½	176 7–15
No. cloudy and foggy d'ys	17	8½	6	14½	12½	9½	7½	5½	11½	14½	10	15½	132½	126 1–15
No. rainy days,	7	16	14	5	4	0	1	....	2	....	16	5	70	63 1–15
Quantity of clouds,	6·3	5·5	3·7	2·9	2·2	0·5	0·7	0·4	1·4	1·3	5·7	4·1	2·9	3·3
Quantity of rain and fog,	0·964	3·906	1·637	0·981	1·037	0·000	0·030	0·000	0·025	0·000	6·485	1·834	16·899	16·927
1st dys & 2d force N. wind	11½	2·3	4½	1·8	8½	3·2	5½	2·5	6	2·9	3	1·0	1	0·6	1½	0·6	7½	2·2	10½	1·4	7½	1·4	14½	1·4	81½	1·7
" " " N.E. "	6	2·0	1	1·7	1	1·2	2½	2 0	1½	1·1	1½	0·4	0	0·0	¼	0·3	0	0·0	2	1·2	1½	1·2	5	1·7	21½	1·1
" " " E. "	1½	1·3	⅜	1·0	1	0 8	1	2·0	⅜	1·7	⅛	0·3	½	0·7	0	0·0	1½	0·5	2⅜	1·4	2	1·7	2	1·8	13½	1·1
" " " S.E. "	6½	2·8	8	3·1	5	3·2	3⅜	1·9	4	1·8	2⅛	1·1	4½	2·2	5⅜	2·3	4	0·8	3⅜	1·6	8⅜	2·7	7	2·1	63	2·1
" " " S. "	2	3·2	8½	3·1	4	2 6	10⅛	2·9	9½	2·6	11	2 2	18	2 5	15	2·5	7½	2·5	5½	2·0	4	3·0	1	2·0	95⅜	2 6
" " " S.W. "	1½	2·5	3⅜	1·8	4⅜	3·2	3	3·0	3⅜	2·3	6⅛	1·7	4	2·3	4½	2·2	5½	2·1	2½	1·0	2	1·7	0	0 0	41	1·9
" " " W. "	0	0·0	2	1·8	4	2·1	3	2·7	2½	1·5	21⅜	1·3	3	2·6	3	1·6	3	1·5	1	0·3	1⅜	1·0	⅛	0·7	26	1·4
" " " N.W. "	2⅜	3·1	0	0·0	2⅜	3 6	1½	3 0	3⅜	2·6	2	0·7	½	0 7	1	0·7	1⅜	1·8	3½	3 3	3	2·1	1	2 3	22⅜	1·8

General Remark.—The climatic feature of predominant interest in California lies in the rains of winter, which, although they fell in the early part of the present season in ample abundance for agricultural purposes, nevertheless, in their subsequent diminution, confirm the opinion expressed by us in former remarks, that the cultivator of the earth cannot depend with any certainty upon them alone, but must be prepared to supply their deficiency, whenever it occurs, by irrigation—for which expedient no other country, perhaps, is better adapted, both as regards soil and climate, as well as facilities of commanding water.

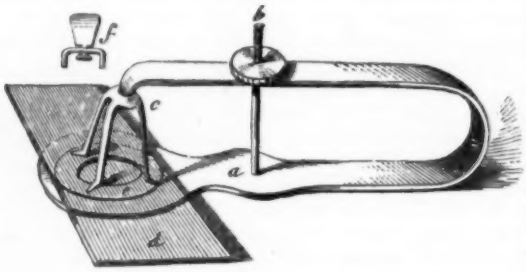
2. *Daylight Meteor of Nov. 15th, 1859.*—Of this remarkable body Professor Loomis has already published an interesting account at p. 137 and 298 of this volume. The meteor being one of the most brilliant on record deserves the fullest possible investigation, and we are glad to find in the Journal of the Franklin Institute of Philadelphia, for March and April, a valuable paper thereon by Mr. Benj. V. Marsh of that city, giving an extensive series of observations which he has collected, together with his deductions therefrom.

The meteor was seen in full sunshine, as a large ball of fire, from Salem, Mass., to Petersburg, Va. Its path was probably inclined to the vertical about 35°, and the direction of its motion was nearly west. Its velocity was very great, perhaps full 30 miles per second, and the meteor appears to have become luminous when more than 100 miles above the earth. During its brief passage of two or three seconds, it exploded several times, with reports which were loud and violent. These reports or detonations made two series, the whole occupying only half a second of time, the individual sounds being distinguishable because of the different distances they had to travel to reach the ear. The column of smoke resulting from the explosions was nearly a thousand feet in diameter, and its base was vertical about four miles north of Dennisville, N. J. The immense volume of smoke or substance of the meteor, dissipated by its excessive heat, shows that the body was of very considerable magnitude. The meteor's path would strike the earth near Hughesville, on the northwestern boundary of Cape May County, N. J., in which vicinity, or a few miles further west, it is probable that fragments may yet be found. Will nobody look for them?

V. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

1. *Probable Origin of Flint Nodules in Chalk.*—Dr. G. C. Wallich, Surgeon in the Indian army, has published (in the Quart. Jour. Microscopical Sci., No. xxx, p. 36) an interesting paper on the siliceous organisms found in the digestive cavities of Salpæ—embracing under this head the whole molluscoid tribes that frequent the open sea in shoals and live upon the microscopic organisms it contains. These creatures are in their turn the food of whales. In the digestive cavities of the Salpæ the siliceous shields of Diatomaceæ, &c., are freed of all or nearly all their soft portions, and these minute organisms aggregate into masses which in the whales are further aggregated and in the form of coprolites fall in vast numbers upon the pulpy cretaceous strata of Foraminiferæ, &c., now known to form the bottom of the ocean in many places, imbedding themselves there as nodules similar to, certainly, if not identical with, the flint nodules in the Chalk.

2. *New form of Compressor for use with the Microscope*, (in a letter to Prof. G. C. Schæffer).—*My Dear Sir*,—At your request I enclose a sketch of the little instrument that I use as a substitute for the ordinary compressor, in mounting objects for the microscope.



The frame *a*, is made from one piece of hard brass, possessing sufficient elasticity for the purpose,—held in place and adjusted by the milled nut on the screw *b*. This screw is firmly riveted in the frame at *a*, and plays freely in a slot at *b*. The swinging tripod, (also cut from one piece,) is loosely riveted to the bent end of the frame as shown in section at *f*, having sufficient play in the collar to adjust itself to any inequality in the slide or the cover.

The centre of the frame, at *c*, under the tripod, is pierced with a hole of sufficient size to see the object to be mounted; so that the pressure from the screw can be adjusted without injury to the object. The sketch shows a slide, *d*, and cover, *e*, in place.

For mounting objects dry, or for covering cells I find it useful as it enables me to hold the cover securely while I have access to its entire edge, and can turn it in every direction to apply the cement. For mounting objects in balsam which require very thin covers, say ·01 to ·005 of an inch, such as the silicious epidermis of plants and other test objects, I add to the pierced hole in the frame a circular shield of glass, a little less in diameter than the cover, and of the thickness of an ordinary slide, imbedding but a small portion of its thickness in the brass. Then, after placing the cover on the balsam, and spreading it by heat, I put the slide cover down in the frame, and apply a pressure to drive off the superfluous balsam. The raised surface of the glass shield, keeps the exuding balsam from the frame, and at the same time prevents any bulging of the thin glass at the centre. Dried in this way, under pressure, it is easily taken from the frame and cleaned. I have found it a very simple and satisfactory way of perfecting the mounting of difficult test objects.

Other modifications of this little instrument will readily sugest themselves to you. It is, to me, a great convenience to have a dozen of them at hand, of various sizes, as I can thus get my slides thoroughly seasoned under a perfectly uniform pressure—and I can have twenty of them made for the cost of one English compressor.

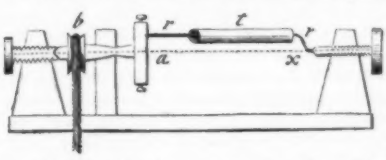
My friend, Mr. McAllister, Optician, 728 Chestnut St., Philadelphia, made them for me from a drawing, very neatly and accurately, at seven dollars and fifty cents per dozen ($\$7\frac{50}{100}$).

Very truly, your friend, S. Morton Clark.

Washington, Jan. 4th, 1860.

3. *On Contraction of the Muscles, induced by Contact with Bodies in Vibration;* by O. N. Rood, Professor of Chemistry in Troy University.—Some time since, when grinding a slide for microscopic purposes, as the strip from time to time accidentally came into vibration, I experienced, in the hand holding it, a numbness, and, at times, an absolute inability to relax the grasp. It seemed as though an involuntary contraction of the muscles had been effected by the vibratory action.

For the examination of this matter, the apparatus seen in the woodcut was devised: *b* is made to revolve at a rate of from 50 to 60 revolutions per second; *r r* is a rod of iron placed excentrically and so that the distance *r a* is equal to $\frac{1}{8}$th of an inch. To protect the hand from blisters, the brass tube *t* encloses the rod, fitting it very loosely.



When the hand is laid on this sheath, the rate of rotation being between 40 and 60 revolutions per second, a feeling of numbness is first perceived; the muscles involuntarily contract with considerable force, and the hand grasps the sheath tightly. As long as this rate of revolution is kept up, it is almost impossible, by an effort of the will, to relax the grasp, just as is the case with the electro-magnetic machine employed for medical purposes. The sensations, indeed, resemble those occasioned by the use of this apparatus, and usually extended as high as the elbows. At the termination of these experiments no particular inconvenience was experienced, although the sensations produced by the higher rates of vibration were painful.

Experiments were made on different parts of the arm and hand. The results obtained differed in degree rather than in kind.

The resemblance of the symptoms and sensations produced by electricity and mechanical vibration, is at least singular, and may eventually throw some light on the method in which electricity causes contractions in the muscles.

Troy University, Feb. 3d, 1860.

4. *Large Object-Glass.*—Messrs. Alvan Clark & Sons, of Boston, have completed on their own account, an object-glass with a focal distance of sixteen feet, and clear aperture of *twelve inches.* It has a nice defining power, and Mimas, the nearer satellite of Saturn, was seen with it Feb. 14th and March 2d and 4th.

5. *Boyden Premium.*—Uriah A. Boyden, Esq., of Boston, Mass., has deposited with the Franklin Institute, Philad., the sum of one thousand dollars, to be awarded as a Premium to "any resident of North America, who shall determine by experiment whether all rays of light, and other physical rays, are, or are not transmitted with the same velocity."

The conditions are given in an advertisement at the end of this Number.

6. *Geological Survey of California.*—We learn that a bill for securing the geological survey of California is now under consideration and if not so already, is likely soon to become a Law. So important an act must meet with the approval of every one interested in the material prosperity of the golden state: while science has much to expect every way from the proper discharge of such a commission.

Book Notices.—

7. *Elements of Chemical Physics;* by Josiah P. Cooke, Jr., Erving Professor of Chemistry and Mineralogy in Harvard University. 8vo. pp. 739. Boston, Little, Brown and Company, 1860.—We cannot state the nature and scope of this important contribution to our scientific literature better than by quoting the following paragraphs from the Author's preface.

"The history of Chemistry as an exact science may be said to date from Lavoisier, who first used the balance in investigating chemical phenomena, and the progress of the science since his time has been owing, in a great measure, to the improvements which have been made in the processes of weighing and measuring small quantities of matter. These processes are now the chief instruments in the hands of the chemical investigator, and it is evidently essential that he should be familiar with the causes of error to which they are liable, and should be able to determine the degree of accuracy of which they are capable. All this, however, requires a theoretical knowledge of the principles which the processes involve, and a chemical investigator who, without it, relies on mere empirical rules, will be exposed to constant error. This volume is intended to furnish a full development of these principles, and it is hoped that it will serve to advance the study of chemistry in the colleges of this country. In order to adapt the work to the purposes of instruction, it has been prepared on a strictly inductive method throughout; and a student who has acquired an elementary knowledge of mathematics will be able to follow the course of reasoning without difficulty. So much of the subject-matter of mechanics has been given at the beginning of this volume as was necessary to secure this object; and for the same reason, each chapter is followed by a large number of problems, which are calculated, not only to test the knowledge of the student, but also to extend and apply the principles discussed in the work. Regarding a knowledge of methods and principles as the primary object in a course of scientific instruction, the author has developed several of the subjects to a greater extent than is usual in elementary works, solely for the purpose of illustrating the processes and the logic of physical research. Thus, the means of measuring temperature and the defects of the mercurial thermometer have been described at length, in order to show how rapidly the difficulties multiply when we attempt to push scientific observations beyond a limited degree of accuracy; so also the history of Mariotte's law has been given in detail, for the purpose of illustrating the nature of a physical law, and the limitations to which all laws are more or less liable; the condition of salts when in solution, and the nature of supersaturated solutions, have in like manner been fully discussed as examples of scientific theories; and, lastly, the method of representing physical phenomena by empirical formulas and curves, which are the preliminary substitutes for laws, has been illustrated in connection with Regnault's experiments on the tension of aqueous vapor."

After advising the student to study the details of science from original memoirs rather than from digests, and enumerating the chief sources from which he has drawn his facts and illustrations, the Author announces his design of following the present volume with two others.

"Although the present volume is a complete treatise in itself of the principles involved in the processes of weighing and measuring, it is also intended as the first volume of an extended work on the Philosophy of Chemistry. The arrangement of the chapters and sections has been adopted with this view, and the inductive method begun in this volume will be extended through the whole work. The second volume will treat of the theory of Light in its relation to Crystallography (including Mathematical Crystallography), and also of

Electricity in its relations to Chemistry. The third and last volume will be on Stoichiometry and the principles of Chemical Classification. This volume is now in preparation, and will be published next."

We have read, or studied, the larger portion of Prof. Cooke's present volume, with care, and, are happy to add, with much satisfaction. It is a more elaborate and thorough discussion of the subjects on which it treats than has before appeared in any text-book. All the important propositions are mathematically demonstrated in a simple but thorough manner.

The volume demands and must receive exact and searching study, and any chemical teacher who intends to employ it as his class book will find it capable of the same treatment which he has been accustomed to regard as peculiar to mathematical text-books. The French units of weight and measure are employed exclusively, and a collection of tables (21 in number) is added for scientific reference and for the convenience of the student and teacher in solving the problems (420 in number) which are appended at the close of each principal subdivision of the subject. The whole subject matter of the volume is treated under five chapters, viz., I. Introduction, II. General Properties of Matter, III. The Three States of Matter, IV. Heat, and, V. Weighing and Measuring.

The mechanical execution of the work is beautiful, and the press seems to have been very carefully supervised.

One circumstance in connection with this work cannot fail to attract the attention of all teachers of Chemistry in American Colleges, namely, that a revision of our whole scientific curriculum is demanded in most of our higher Institutions in order to admit of the expansion demanded by the introduction of such a treatise as Cooke's Chemical Physics into the course of study. Such a change Prof. Cooke has been able to effect since his appointment at Cambridge, and now his chemical teachings fill a course of recitations and lectures commencing in the Sophomore year and covering two or three years. This is a great change in the policy of a college where this subject was formerly a by-word, and it offers every encouragement for efforts to secure a similar change in other leading colleges. For this reform, as for the high scientific character of his present work, Prof. Cooke will receive the hearty thanks and esteem of all teachers in this department of science.

8. *Smithsonian Miscellaneous Collections.*—Catalogue of the Publications of Societies and of the periodical works in the Library of the Smithsonian Institution, July 1, 1858. *Foreign works.* Washington, 1859. pp. 259, 8vo, with a Supplement.—The arrangement of this catalogue is geographical, commencing with Scandinavia and ending in Europe with Great Britain. It is followed by an alphabetical Index to Learned Societies, and another of miscellaneous publications, chiefly Journals. The Smithsonian Library possesses, as appears from this list, the Transactions in full or in part of 501 Institutions and Learned Societies, and series, more or less complete, of 254 Scientific Journals exclusively foreign. The domestic publications form the subject of another catalogue. It is a most valuable aid to the student in ferreting out the often enigmatical references constantly found in books of science, and for determining the probability of being able to verify such references by a visit to Washington, or by correspondence. Only those who have undertaken researches can appreciate the value of such an aid.

9. *The New American Cyclopædia.* Vol. IX. New York, D. Appleton and Co., 1860.—This volume contains some fifty articles on zoölogical subjects. Some of them are of considerable length and show marks of much care and labor. The sections on Herpetology and Ichthyology are especially to be commended for the plan on which they are written. Instead of entering into trivial details the author has confined himself to giving the ways in which the best authors have arranged the divisions of Reptiles and of Fishes. The subject is thus properly kept within scientific limits. The more popular treatment is reserved for particular animals or for the minor zoölogical divisions. Thus, there is a very interesting and acceptable article on the Horse, and another on Insects. Some of the definitions are not quite precise, and terms are, in one or two instances, somewhat loosely applied: *e. g.*, speaking of the nervous system of an insect as a "brain and spinal cord." But these are of little consequence compared with the general good judgment and accuracy displayed. Nor is it too much to say that these contributions are far better than those commonly met with in Cyclopædias. It is understood that the zoölogical articles are from the pen of Dr. Kneeland, Secretary of the Boston Society of Natural History.

Other articles on scientific topics in this volume worthy of particular mention are Iron and the Iron manufacture by Mr. Hodge, and that on Isomerism by Dr. F. H. Storer, who is also the author of an excellent article on Chemistry in a former volume.

Among the living scientists of whom biographies are given we notice Herschel, T. S. Hunt, and C. T. Jackson.

10. *Cavendish Socy's. Ed. of Gmelin's Hand Book of Chemistry*, vol. XIII.—This is vol. VII of Organic Chemistry embracing organic compounds containing sixteen and eighteen atoms of carbon. The Cavendish Society announce that they will give only one volume for 1857, '58, and '59. This action of the Society is not well calculated to content their subscribers or to invite new recruits. But we can well imagine that the Council have found Gmelin a heavy load and that they are anxious to close it before undertaking any new publication; meanwhile let us hope that "Rose's Analytical Chemistry," long since undertaken, will not be unnecessarily delayed.

11. *Lieber: Geology of South Carolina.* Report IV. 1859. 8vo, pp. 194. Columbia, S. C. Apr. 2, 1859.—We have already announced (this vol., p. 287) the unfortunate discontinuance of the South Carolina Survey from an unwise withholding of the requisite appropriation of money. Dr. Leiber in this Report sums up his results and presents some general discussions on Metamorphism, a subject certainly of much importance in both a scientific and economic view in South Carolina. The Geognostic maps of Anderson and Abbeville districts and the "Industrial map" of the State, are very neatly printed in colors by Colton of New York.

Some of the most important subjects of this Report have already been laid before our readers, *e. g.*, the evidence of a change of level on the coast of South Carolina and the mineralogical details.

12. *Fundamental Ideas of Mechanics and Experimental Data*, by A. Morin. Revised, translated and reduced to English Measure, by Joseph Bennett, Civil Engineer. New York, Appleton and Co., 1860.—This

work is designed to illustrate the practical application of mechanics to the construction of machinery, draught vehicles, ship building, &c., and contains experimental data of great value in calculating the resistance to be overcome in the form of friction, vibration and wear and tear of machinery and other structures. The work is of great value to practical engineers and machinists and we rejoice to see it presented to the public in an English dress.

13. *Gangstudien, oder Beiträge zur Kenntniss der Erzgänge*, Dritter Band, drittes und viertes Heft.—The continuation of this valuable work, edited by Prof. Cotta and Herrmann Müller, contains a very important paper by Müller, on the relation between *mineral springs* and *mineral veins* in Northern Bohemia and Saxony; also, an extended article on *itacolumite*, its associates, and the metal bearing characters of the same, by Oscar M. Leiber, late State Geologist of South Carolina.

Ferrel, Wm., A.M.: The motions of fluids and solids relative to the Earth's surface; comprising applications to the winds and currents of the Ocean. From the Math. Monthly, Vols. I. and II. New York, Ivison and Phinney. 1860. pp. 72. [A very important discussion an abstract of which, prepared by the Author, we shall present at an early day].

Wilkes, Capt. Chas, U.S.N.: On the circulation of the Oceans. Phila., 1859. pp. 24, 8vo.

Hennessy, Henry, F.R.S., M.R.I.A.: A Discourse on the Study of Science and its relations to individuals and to society. 2d edition, Dublin, 1859. 8vo., pp. 54.

Kirkby, J. W.: On Permian Entomostraca from the shell limestone of Durham, with notes by T. R. Jones, F.G.S. XI plates. 8vo, pp. 17.

Parker, W. K. and T. R. Jones: On the Nomenclature of the Foraminifera, (from Ann. and Mag. Nat. Hist., Nov., 1859). 8vo, pp. 17.

Bellardi Luigi: Saggio di Ditterologia Messicana. Parte 1ª, Torino Della Stamperia Reale. 1859. 4te, pp. 77. *Tav* II.

Logan, Thos. M., M.D.: Report on the Medical Topography and Epidemics of California. Phila., 1860. pp. 58, with maps.

Stevenson, D. and T.: Answer to Sir David Brewster's Reply to Messrs. Stevenson, on Sir D. B.'s memorial to the Treasury. Wm. Blackwood and Sons. 1859. 8vo, pp. 16.

Forget, A.M., M.D., etc.: Dental Anomalies and their influence upon the production of diseases of the maxillary bones. (Prize essay), translated from the French. Jones and White. Philadelphia, 1860, pp. 34, with vi plates.

Durand, Elias: Memoir of the late Thomas Nuttall, (from the proceedings of the Am. Phil. Soc.). 8vo, pp. 19. 1860, Phila.

Royal Society, London, Proceedings, Nos. 35, 36 and 37, from May 26, 1859, to January 12, 1860. 8vo, pp. 1–234.

Hall, James: Contributions to the Palæontology of New York, being some of the results of investigations made during the years 1855–1858, being part of the 12th Annual Report of the Regents of the University of the State of New York. March 15th, 1859. Albany, 8vo, pp. 110.

Harris, Elijah P.: The Chemical Constitution and Chronological Arrangement of Meteorites (an inaugural dissertation). Göttingen, University Press. 1859. pp. 131.

Isaac Lea: Observations on the genus Unio, &c., Vol. 7, Part II, with 25 plates, 4to, read before the Acad. Nat. Science. Philadelphia, 1859.

Haidinger (Wm.): Ansprache gehalten am Schlusse des Ersten decenniums der K. K. Geolg. Reichanstalt in Wein, 22 Nov., 1859. 8vo, pp. 38. 3 plates.

(The same). *Die Rutilkrystalle von* Graves Mount in Georgia. 5 January, 1860.

J. B. Schneider und Ernst Hartig: Untersuchungen über dir Heizkraft der Steinkohlen sachsens: Leipzig, W. Engelmann. 1860. 4to, pp. 509. Taf. IV. This is the third and concluding part of the great government research on the Coals of Saxony. Dr. Geinitz prepared the volume on their Geology and Prof. W. Stein

is the author of the Chemical volume. The three parts form by far the most complete research on this important subject hitherto published.

Dr. J. Lamont: Magnetische unterschungen in Nord-Deutschland, Belgien, Holland, Dänemark, München. 1859, 4to, pp. xlv, Tab ix.

(The same.) Untersuchungen über die Richtung und Stärke des Erdmagnetismus, &c., München, 1858, 4to, pp. cxv.

Ludwig Seidel: Die Theorie der Lichterscheisung des Saturn München, 1859, 4to, pp. 102, 1 chart.

Von Martius (Dr. Carl): Eine Rede zur feifer des Akademischen Saecularfestes am. 29 März, 1859. München. 4to pp. 74.

Feistmantel (Carl): Die Porphyre im Silurgebirge von Mittelböhmen, 4to, pp. 42. 2 Tafeln.

Daguerin, P. A.: Traité de Physique, tome iii, 8vo, pp. 1007, avec Table alphabetique et analytique. Toulouse et Paris, 1860. This volume contains the close of Electricity, and Optics.

Proceedings Boston Soc. Nat. Hist., 1859.—p. 135, On the recent eruption of Mauna Loa; *H. M. Lyman.*—p. 138, Descriptions of new shells brought home by the North Pacific Expedition; *A. A. Gould*—p. 142, List of Plants collected by E. Samuels in California; *A. Gray.*—p. 145, List of Plants collected by J. Xantus at Fort Tejon (5 new species); *A. Gray.*—p. 150, Natural History, etc., of Mohawk, Herkimer Co., N. Y.; *Whittemore.*—p. 153, On vibrating dams; *W. Edwards.*—p. 155, Experiments with the Japan Wax-plant, Rhus succedaneum; *E. S. Rand.*—p. 159, Habits of Esox fasciatus; *G. Curtis.*—p. 160, Green feldspar from Mt. Desert, Me.; *C. T. Jackson.*—p. 161, New shells of the North Pacific Expedition (of the genera Patella, Acmæa, Scutellina, Emarginula, Rimula, Chiton, and Dentalium); *A. A. Gould*—p. 166, On reversed bivalve shells; *L. Agassiz.*—p. 167, On Odontaspis griseus; *D. H. Storer*—On the shedding of the antlers of the American red deer; *J. Wyman.*—p. 168, On the Carboniferous rocks of Nova Scotia and the United States; *W. B. Rogers*—p. 174, On larvæ vomited from the human stomach, and on a new Gordius, G. trifurcatus; *White.*—p. 175, On a great meteorite recently discovered in Oregon; *Evans* and *Jackson.*—p. 176, On the geology of the shores of the Bay of Fundy; *W. B. Rogers.*—p. 176, On the meteor of August 11th, 1859; *D. A. Wells.*—p. 179, On the transformations of the Cecidomyiæ, a posthumous paper by the late *Dr. T. W. Harris.*—p. 184, On Diatomaceæ prepared by Mr. Samuels; *Stodder.*—p. 185, On Cicindela Hentzii; *Harris.*—p. 189, Synonymy of three North American butterflies; *Harris.*—p. 191, On the Arrangement of Zoological Museums; *L. Agassiz.*—p. 192, Experiments on frogs; *B. J. Jeffries.*—p. 193, Descriptions of new Ophiuridæ belonging to the Smithsonian Institution and to the Museum at Cambridge; *T. Lyman.*—1860. p. 208, On flattened pebbles found in the conglomerate of Vermont; *E. Hitchcock, Jr.*—p. 209, On a mineral substance found in the medullary cavity of trees at the Sandwich Islands by Dr. Winslow; *A. A. Hayes.*—p. 211, On the Gorilla; *J. Wyman.*—p. 213, Chronological Index to the Entomological papers of T. W. Harris, M.D.—p. 222, On the lower jaw and a tooth of Physeter macrocephalus; *J. C. White.* s.

Proceedings Philadelphia Acad. Nat. Sci., 1860.—p. 3, Number of species of American Unionidæ; *I. Lea*—Mosasaurus bones from New Jersey; *J. H. Slack.*—p. 4, Contributions to North American Lepidopterology, No. 3; *B. Clemens.*—p. 15, Appendix to paper on new genera and species of North American Tipulidæ with short palpi, etc.; *R. Osten Sacken.*—p. 17, Catalogue of the Mollusks of Mohawk, N. Y.; *J. Lewis.*—p. 19, Notes on the nomenclature of North American fishes; *T. Gill.*—p. 22, Prodromus descriptionis animalium evertebratorum, etc. Pars VIII, Crustacea Macrura; *W. Stimpson.*—p. 47, Mexican Humming birds; *R. M. de Oca.*—p. 49, Geographical distribution of Coleoptera; *J. L. Leconte.*—Geographical distribution of the Helices of North America; *W. G. Binney.*—p. 51, Reversed Unionidæ; *I. Lea.*—p. 55, Illustrations of fossils; *Conrad* and *Gabb.*—p. 55, Descriptions of new species of American fluviatile gasteropods; *J. G. Anthony.*—p. 72, Supplement to Catalogue of Venomous Serpents; *E. D. Cope.*—p. 74, Catalogue of the Calamarinæ in the Museum of the Academy; *E. D. Cope.*—p. 80, Descriptions of new species of Cyrena and Corbicula; *T. Prime.*—Mexican Humming-birds; *R. M. de Oca.* s.

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